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NEW METHODS IN SUBMARINE TELEGRAPHY.

THE immense value to this country, and to the Empire generally, of the vast network of submarine cables that has been woven beneath the seven seas by British industry and enterprise was never more convincingly demonstrated than during the present war. How many reams have been written in pre-war times in anticipation of a European war in which we should be involved, and in which the preservation of our submarine communications would be of supreme importance to our welfare, we should find it difficult to estimate. Happily for us, our Navy soon swept the seas clear of hostile cruisers and freed us from anxiety on this score for the time being, but it is obvious, as we remarked last week, that had we been opposed by a different combination of foreign powers, our position with regard to the safety of our cables might have been very gravely imperilled. Even now it is not impossible that attempts will be made—perhaps they have been made—to interrupt our communications by certain means; though such attempts are not likely to succeed, the possibility should not be ignored.

Meanwhile, aloof from war's alarums, the scientist pursues his tranquil way and seeks to improve upon existing methods, with the success to which our columns have repeatedly borne witness. Amongst the most remarkable developments of recent date is that which Lieut.-Col. Squier describes and explains in his paper, read before the Physical Society of London, of which a very full abstract is concluded in this issue. The fundamental idea of his invention is revolutionary in character, though not absolutely novel in conception. We have been accustomed to look upon a long submarine cable as a great reservoir of capacity, like, say, a long but narrow canal; we start a comparatively huge wave at one end of it, which arrives at the other end in the form of an attenuated ripple, barely perceptible with the aid of the most refined and delicate instruments; and various ingenious devices have to be employed to wash out the undesired and useless effects of the original disturbance, in order to clear the way for the following signal. Col. Squier, who has worked on the subject of trains of waves for many years, conceived the idea that if a regular succession of waves were sent into the cable *in unbroken sequence* and of the most efficient form (sinusoidal), the irregular and ungovernable effects met with in the existing system would be eliminated; instead of a series of abrupt and violent impulses, charged with innumerable harmonics, being impressed upon the cable at one end, with the result that the conditions in the cable differed from point to point throughout its length, the cable would be kept in a state of continuous gentle electrical oscillation at every point, the only variations being the slight differences of amplitude corresponding to the signals and spaces. Thus order would be brought out of chaos; sending conditions would be immensely improved, and the speed of transmission greatly accelerated.

How this can be done will be found explained in Colonel Squier's exceedingly interesting paper, not the least significant and noteworthy feature of which is the fact that he approaches the question from the standpoint of the electrical engineer transmitting power to a great distance, and seeking to accomplish this in the most efficient and workmanlike manner. We heartily congratulate the inventor upon his

achievement, which seems likely to revolutionise practice in connection with long cables.

At first sight it may seem a small thing to increase the speed of transmission by, say, 50 per cent.; but when it is remembered that an Atlantic cable costs something like £500,000, and that a 50 per cent. increase of speed means that two such cables will do the work of three, the enormous importance of the matter to the cable world and to those who telegraph will be appreciated. We believe that Col. Squier's invention is expected to produce a far greater improvement even than this.

Missing the Point.

A LEADERETTE in the *Electrical World*, of July 10th, dealing with the "Point Five Tariff" discussion at the I.M.E.A., curiously misses the point of the matter in a double sense—in the first place by explaining that the tariff involves as a secondary rate "$\frac{5}{10}$ths penny per kilowatt hour," and in the second by making the following comment:—"As regards the load, the new tariff in the case of two cities specially described quite doubled it, but in both cases the gross revenue from residences did not rise proportionally, so that the average price per unit was quite cut in half. As the usual English city plant is municipally owned, the 'point five' tariff may perhaps not unjustly be regarded as a sop to the rate-payer."

We can assure our contemporary that the rate-payer, as such, keeps a very keen eye on the tariff question, and would strongly resent any sort of "sop" to the consumer if he thought it involved supplying the latter at less than cost price. But the point that has been missed is the fact, which we should have thought no electrical editor could overlook, that while the load was increased by the adoption of the tariff, the additional units were mainly "off the peak," and consequently cost less by far than the original demand. The average price per unit was reduced, as a matter of course—but it by no means follows that *the average profit per unit* was decreased, and even if it were, it still by no means follows that the *net profit per consumer* was decreased. On the contrary, the results on a commercial basis have been eminently satisfactory to the managers who have adopted the tariff in one form or another. Mr. Roles's reply to the discussion, of which we published the gist last week, will help to convince our contemporary that its rather superficial appraisal of the system was erroneous. It is not, as stated, a "cut-rate scheme."

Rubber.

SOME temporary irregularity was seen recently in rubber, which arose mainly from the fact that spot and near parcels were held for pretty high figures, while, on the other hand, there were some interests having fair lines at their disposal who seized the opportunity to dispose of their contracts. On the whole, however, the tone has been fairly good, and undoubtedly fair quantities of the plantation product have been disposed of to the consuming trades, although activity has scarcely been up to the level of that experienced some few weeks ago. The consuming sections, however, are exceedingly busy in all parts of the country, and the tire factories and kindred works are running night and day, their output being limited only by the labour forces available. There seems no disposition, however, on the part of consumers to rush heedlessly into the making of fresh purchases, though this need arouse no concern in view of the remarkable activity prevailing in all consuming connections.

The arrivals which have come to hand have been pretty fair, and they are expected to show a material increase during the next few months. From estimates which have been prepared, it is believed that the output of the Federated Malay States this year will show a considerable increase. Last year the yield, taken over a wide range of estates, varied from 230 to 447 lb. per acre, the average being somewhere between 300 and 350 lb.

There has been some searching of hearts regarding the way in which Germany has been getting supplies of rubber. Undoubtedly a portion of the rubber which has entered the country since the war was smuggled in from the United States, and this in spite of all the efforts made to lock the door. The matter is being very seriously considered by the Rubber Growers' Association, which influential body as soon as war broke out directed the attention of the Government to the fact that Germany was trying to buy rubber here. Restrictive steps were taken, and it is the general impression that these have been very successful. At all events, private information which leaks through from the Continent suggests that Germany is beginning to want rubber pretty badly, and there can be no doubt that everything possible will be done as far as British interests are concerned, to starve out the Huns.

Official advices announce that the exports of plantation rubber from the Straits Settlements during June totalled 2,249 tons against 3,588 tons in May, and 1,480 tons in the corresponding month of last year, details being as follows:—

	1913.	1914.	1915.
January...	784	1,181	2,576 tons.
February	743	1,703	2,741 ,,
March	898	1,285	2,477 ,,
April	762	1,548	1,978 ,,
May	814	1,309	3,588 ,,
June	812	1,480	2,249 ,,
Total ...	... 4,813	8,506	15,609 ,,

This figures include transhipments of rubber from various places in the neighbourhood of the Straits Settlements, such as Borneo, Java, Sumatra and the non-Federated Malay States, as well as rubber actually exported from the Colony, but do not include rubber exports from the Federated Malay States.

The Wire-Drawing Trades.

THE demands for copper, bronze, and steel wire, &c., during the last month have maintained the substantial level recorded in previous months of the war, and the conditions ruling throughout the trades are much the same as before. The demands for electrolytic copper have continued to be heavy, particularly in the fine wires, in which section probably the productive capacity of every machine in the country is being taxed to the utmost. The chief sources of trouble are undoubtedly the skilled labour problem and the inability to obtain new machines from the makers, whose output is also subjected to similar restrictions. In other instances entire sets of machines are standing for want of skilled labour to work them.

In regard to the question of the re-exportation from Holland into Germany, &c., of copper goods originally shipped from this country, the probabilities are that the actual facts have been somewhat exaggerated by statists and others. According to the authority of the Dutch Government officials, very little, if any, copper goods from England are being allowed to be re-exported into Germany and elsewhere. The deduction appears to be, therefore, that trade between Germany and Holland must have practically ceased. In 1912 the exports from Germany into Holland, it is interesting to note, amounted to £180,500. Between them, England and America, as far as trade conditions will allow, are supplying almost the entire overseas demands of Holland, as well as Denmark and other European markets which were very largely dominated in the past by German influence.

It is generally well known among wire manufacturers in this country, and in America, that the productive capacity of the German firms, all of which are working under the greatest difficulties, is being largely anticipated by Government requirements, and the small surplus left over is eagerly absorbed by local requirements. The exports of copper goods from Germany during the past month or so must have been exceedingly small, even allowing for the labour difficulties in that country. In 1912 Germany exported into this country alone copper goods to the value of £317,800. Here, at least, we know of one market which can with confidence be said to be entirely free, for the present, at any rate, of German influence.

THE CASE FOR THE ELECTRIFICATION OF CANE SUGAR MILLS AND REFINERIES.

By ERNEST P. HOLLIS, A.M.I.E.E., A.Am.I.E.E., M. Assoc. Mining Elec. Eng.

Sugar is manufactured from three main sources:—(*a*) from sugar cane; (*b*) from beet; (*c*) from starch. The first, which was the earliest process, has now been strongly challenged in recent years by the second, and competition between the two has had the inevitable result not only of bringing about a reduction in prices but also of compelling the rival manufacturers to install the most modern plant in order to make their competition effective. With regard to these three sources, it may be remarked that sugar produced from starch is the impurest and the cheapest. It is largely used for sweet-making and for adulterating the better classes of cane and beet sugar.

Recent events have had the effect of considerably improving the situation of the cane sugar manufacturer, with the result that one hears from the various sugar manufacturing centres that increasing interest is being taken in proposals for improving the sugar-making plant, in consequence of which electrification looms largely in the mind of the manufacturer. At the present moment two of the largest beet sugar producing areas in the world are in the grip of war—Germany and Northern France. Sugar is not now exported from Germany overseas, and, in addition, many of the sugar refineries in the North of France have been completely destroyed. In fact, it is known that the German armies have paid special attention to the destruction of these factories in order to remove competition with their own. Further, when the actual fighting is transferred to Germany, the German beet sugar refineries are bound to suffer severely. In consequence, the cane sugar manufacturer looks forward to the near future with considerable confidence, and it is known that capital is to be extensively employed in the improvement of the cane sugar manufacturing plants in various parts of the world.

The present remarks relate solely to the manufacture of cane sugar, and a brief conspectus of the process will now be given.

Manufacture of Cane Sugar.—Sugar cane is a grass attaining a height of as much as 15 ft. It is cut by natives and loaded into carts for conveyance to the factory. On arrival there it is handled by endless conveyors and delivered to large crushing mills, in which it passes first through a crusher proper and then through several sets of rolls. There may be as many as six sets of rolls, each unit composed of three rolls arranged with their centres of rotation forming a triangle. At each set a certain proportion of the juice is extracted. After emerging from the crushers the cane may be passed along to a second crusher for further treatment, or it may be directly handed over to the furnaces for burning. In any event, the furnace is its ultimate destination.

The juice which has been extracted from the cane is caught in the mill-bed and drains into a collecting tank for straining, after which it is pumped up to defecators, mentioned later. The detached portions of the cane collected in the strainers are returned to the mills continuously. The next step is the neutralisation of the acid juice in alkalisers by adding milk of lime. The raw juice has a tendency quickly to ferment, so that on its way from the alkalisers it needs to be treated in order to stay the fermenting processes. A defecator in the simplest form is merely a copper boiler surrounded by a cast-iron steam jacket. Steam is admitted to the jacket and the juice is permitted to simmer. As a result of chemical action with the lime a precipitate forms, and the lighter impurities rise to the top in the form of a scum, while the heavier ones fall to the bottom. The clarified juice is drawn off, leaving the scum and dregs. These are not immediately rejected, but are boiled, filter-pressed, steamed and again washed to extract further remaining juice. The residue from the presses is an excellent fertiliser and is sold for this purpose.

After leaving the defecator the drawn-off juice is then sharply boiled in an "eliminator" and the scum removed. It is then allowed to settle in order to permit the dregs to separate out, or, in the alternative, forced through a filter.

At this stage the liquid is clear and limpid, and the next process consists of boiling in evaporators for the purpose of crystallising out the sugar. To this end an economical multiple arrangement of pans is frequently adopted. The first pan is heated by low pressure steam, and the vapours emanating are passed to a second pan, which is thereby heated up; the vapours from the second pan heat up a third pan, which works under a vacuum. The liquid is passed first from one pan to another, the process in the last being conducted to the point of crystallisation. Sometimes a quintuple evaporator is installed. Here the crystallised sugar is induced to form, in the first place by causing a drop in temperature of the saturated solution. This may be accomplished by shutting off the steam supply or adding cold juice. The crystals formed are in the first place quite small, and need to be built up by introducing fresh syrup. The art in this process is to avoid the formation of small crystals, and when the process is carried as far as possible and the contents of the pan discharged, the mass consists of sugar crystals and sugar solution. If allowed to cool at rest the small crystals are also formed, and therefore the mass is thrown into agitators until it is finally taken to the centrifugal.

By the aid of these centrifugal machines running at about 1,000 R.P.M. the crystals are separated from the molasses. The molasses escapes through holes in the containing vessel or basket, leaving a brown crystal known as "first sugar." To recover the considerable sugar contents the molasses is subjected to a long stirring, and is again boiled down and passed through the centrifugals. "Second sugar" is thus obtained which has to be specially treated to convert it into white sugar. By now the molasses is usually so impure as to be incapable of further crystallisation. Often it is sold as a by-product or, alternatively, it may be chemically treated and freed from the potassium salts it contains, finally being whirled in centrifugals. The residue is then sold as a fertiliser or stock food. The wet sugar from the centrifugals is passed on to granulators, where it is dried by a current of hot air and a revolving steam drum; after this it is cooled by a current of cold air in a revolving tube. It then passes to the automatic sacking machine for dispatch to the refineries, which may or may not be operated in conjunction with the mill.

Sugar Refineries.—Raw sugar emanating from the mill previously described contains so many impurities that it becomes imperative to subject it to a further refinement. The sugar usually leaves the mills sewn up in sacks and in the form of yellow or brown crystals. The refining processes take several forms. In some refineries the colouring matter and other impurities are removed by dissolving the sugar in distilled water. After being boiled down, as in the case of the first molasses, the solution is bleached by sulphur dioxide and filtered through charcoal. The syrup is then crystallised down in vacuum pans heated by low pressure steam in a similar fashion to the crystallising processes described in connection with the sugar mills.

Cube sugar is made by boiling the solution down by steam and leaving it to crystallise out in moulds. The slabs thus formed are cut up by circular saws.

This concludes the description of the technical processes of making sugar, and attention may now be

directed to the question of supplying the power for driving the mills.

Present Steam Power Plants in Sugar Mills.—Cane sugar-mills not electrified derive all their power from steam. The cane refuse or "bagasse," as it is technically called, is burned under low pressure boilers (about 80-lb. per square inch gauge pressure), and the steam is distributed through the works by a complex network of steam mains working at a great inefficiency. In many cases the bagasse is burned under the boilers in the state it leaves the crushing mills, and is not dried, as discussed later. The live steam is supplied to the engines in each of the buildings for driving line shafts, as well as to special engines for operating the crushing mills, while the exhaust steam is utilised for the heating processes. The majority of sugar mills are dependent upon a distant water supply, which has to be pumped by special steam plant often situated many miles away from the main buildings. This water is required for irrigation, for the refining processes, as well as for the boiler feed. Owing to the inefficiency of the general arrangement, the bagasse itself is inadequate in amount for supplying the steam, and resort has to be made to oil and coal as supplementary fuels, and these are generally costly in sugar-cane districts. The fuel thus burnt under the boilers generates steam which drives the main auxiliary mill engines, the exhaust steam passing to the steam heating system. Engines of some 200 to 250 H.P. each drive the different rolls and crushers, while other engines drive the smaller plant such as pumps, crystallisers, centrifugals and so forth.

One point deserves particular attention. From the exhaust steam both mechanical power for driving and energy for heating is required. These two requirements bear no fixed relation to one another. At one time of the day more heat may be required than at another time, while again more power may be necessary at one particular moment than at another. But both power and heat are derived from the same steam. If the momentary demand for exhaust steam be small, the exhaust steam must be wasted; it is impracticable to store it. A scheme which permits as much power and as much heat to be drawn as may be momentarily required affords improvements in economy that mean important savings to the manufacturer. Electrification, as will be seen later, effects this economy.

Before proceeding further, it may be advantageous to inquire more closely into the value of fuel economy to the sugar manufacturer. It has been mentioned that purchasing fuel is a costly item to the manufacturer, and an example will be quoted bringing home the importance of fuel economy:—Taking as an example a large mill turning out 35,000 tons of sugar a season, since for every ton of sugar produced there will be about five tons of bagasse, the mill would have available for fuel 185,000 tons of bagasse. Even in the best appointed steam-driven mills, the bagasse only serves for about 85 per cent. of the fuel, so that the equivalent of 32,000 tons of bagasse has to be purchased. Five tons of bagasse are equivalent in heating value to about one ton of coal, so that 6,400 tons of coal must necessarily be purchased during the season. Sugar-cane fields are, in the majority of cases, very inconveniently situated with regard to the coal fields, and Cuban sugar millers, for instance, pay 30s. a ton for their coal in normal times. In the case quoted, nearly £10,000 is the cost of the extra fuel needed.

The question then arises, can electrification with its inevitable economy either partly or wholly eliminate the necessity for buying extra fuel? Experience shows that, without a shadow of doubt, it can eliminate the whole, and can, indeed, carry matters further.

At first sight it might appear a work of supererogation on the part of the electrical engineer to attempt to pursue fuel economy beyond the elimination of purchased coal. But it is not so, and this introduces the point that in sugar manufacture, as in every other industry, electrification means increased production. Production increases of varying degrees of importance are experienced in electrically driven sugar factories in the various departments through the change from steam to electrical drive; but, at one step, in sugar manufacture the increase is of marked dimensions. It occurs in the process known as maceration.

After the cane has been crushed and rolled a certain percentage of sugar remains in the bagasse. It is easy enough to extract it by washing the bagasse in warm water, but then the sugar can only be rendered available by evaporating the water, and this means fuel, coal or oil. At a matter of fact, steam-driven mills find it uneconomical to resort to maceration to any extent, but they know the sugar is there to be extracted, so that if electrification can effect such economies in the mill that exhaust steam is available for evaporating after maceration it can be very usefully employed. Further mention is made of this point later.

(*To be concluded.*)

TRADE STATISTICS OF BRAZIL.

The following figures show the imports into Brazil of electrical and similar goods during the year 1914. The figures for 1913 have been added for purposes of comparison, and notes of increases or decreases, as the case may be, are given:—

	1913. Dollars.	1914. Dollars.	Inc. or dec. Dollars.
Electric cable.—			
From United States ...	162,000	80,000	– 82,000
,, Great Britain ...	408,000	127,000	– 281,000
,, Germany	167,000	77,000	– 90,000
,, Other countries ...	86,000	51,000	– 35,000
Total	823,000	335,000	– 488,000
Insulators.—			
From United States ...	64,000	32,000	– 32,000
,, Germany	104,000	41,000	– 63,000
,, Other countries ...	30,000	17,000	– 13,000
Total	198,000	90,000	– 108,000
Electric machinery.—			
From United States ...	1,596,000	686,000	– 910,000
,, Germany	789,000	272,000	– 517,000
,, Great Britain ...	674,000	421,000	– 253,000
,, France	127,000	123,000	– 4,000
,, Other countries ...	161,000	118,000	– 43,000
Total	3,347,000	1,620,000	– 1,727,000
Electric motors.—			
From United States ...	215,000	99,000	– 116,000
,, Germany	169,000	55,000	– 114,000
,, Great Britain ...	94,000	40,000	– 54,000
,, Switzerland ...	38,000	22,000	– 16,000
,, Other countries ...	81,000	7,000	– 74,000
Total	597,000	223,000	– 374,000
Stationary engines.—			
From United States ...	10,000	21,000	+ 11,000
,, Great Britain ...	75,000	39,000	– 36,000
,, Germany	227,000	37,000	– 190,000
,, Other countries ...	12,000	46,000	+ 34,000
Total	324,000	143,000	– 181,000
Industrial machinery.—			
From United States ...	269,000	158,000	– 111,000
,, Great Britain ...	939,000	398,000	– 541,000
,, Germany	1,252,000	309,000	– 943,000
,, France	940,000	206,000	– 734,000
,, Other countries ...	225,000	94,000	– 131,000
Total	3,625,000	1,165,000	– 2,460,000
Rails, fish plates, and railway accessories.—			
From United States ...	1,958,000	922,000	– 1,036,000
,, Belgium	2,786,000	425,000	– 2,361,000
,, France	3,673,000	365,000	– 3,308,000
,, Germany	2,019,000	215,000	– 1,804,000
,, Great Britain ...	718,000	166,000	– 552,000
,, Other countries ...	77,000	123,000	+ 46,000
Total	11,231,000	2,216,000	– 9,015,000

	Dollars. 1913.	Dollars. 1914.	Dollars. Inc. or dec.
Lighting apparatus.—			
From United States ...	49,000	29,000	– 20,000
,, Germany	238,000	74,000	– 164,000
,, Great Britain ...	105,000	39,000	– 66,000
,, Other countries ...	102,000	17,000	– 85,000
Total	494,000	159,000	– 335,000
Other machinery (except agricultural).—			
From United States ...	2,187,000	909,000	– 1,278,000
,, Great Britain ...	2,185,000	1,269,000	– 916,000
,, Germany	2,532,000	782,000	– 1,750,000
,, France	969,000	488,000	– 481,000
,, Belgium	102,000	44,000	– 58,000
,, Italy	199,000	61,000	– 138,000
,, Switzerland ...	110,000	66,000	– 44,000
,, Holland	39,000	533,000	+ 494,000
,, Other countries ...	265,000	107,000	– 158,000
Total	8,588,000	4,259,000	– 4,329,000
Telegraph and telephone posts, and bridge and fence material.—			
From United States ...	253,000	62,000	– 191,000
,, Belgium	587,000	92,000	— 495,000
,, Great Britain ...	431,000	337,000	– 94,000
,, Germany	445,000	197,000	– 248,000
,, France	92,000	39,000	– 53,000
,, Other countries ...	57,000	17,000	– 40,000
Total	1,865,000	744,000	– 1,121,000
Copper wire.—			
From United States ...	34,000	12,000	– 22,000
,, Germany	84,000	18,000	– 66,000
,, Great Britain ...	25,000	13,000	– 12,000
,, Other countries ...	23,000	10,000	– 13,000
Total	166,000	53,000	– 113,000
Iron and steel wire.—			
From United States ...	145,000	70,000	– 75,000
,, Germany	1,113,000	390,000	– 723,000
,, Belgium	72,000	16,000	– 56,000
,, Great Britain ...	109,000	65,000	– 44,000
,, Other countries ...	105,000	68,000	– 37,000
Total	1,544,000	609,000	– 935,000
Rubber manufactures.—			
From United States ...	80,000	25,000	– 55,000
,, Germany	188,000	58,000	– 130,000
,, Great Britain ...	237,000	79,000	– 158,000
,, France	82,000	47,000	– 35,000
,, Other countries ...	63,000	47,000	– 16,000
Total	650,000	256,000	– 394,000
Hydraulic pumps and accessories.—			
From United States ...	127,000	51,000	– 76,000
,, Great Britain ...	130,000	63,000	– 67,000
,, Germany	97,000	56,000	– 41,000
,, Other countries ...	96,000	46,000	– 50,000
Total	450,000	216,000	– 234,000
Scientific instruments.—			
From United States ...	118,000	61,000	– 57,000
,, Germany	174,000	101,000	– 73,000
,, France	84,000	50,000	– 34,000
,, Great Britain ...	77,000	27,000	– 50,000
,, Other countries ...	31,000	13,000	– 18,000
Total	484,000	252,000	– 232,000

GEAR-DRIVEN DIRECT-CURRENT TURBO-GENERATOR SET.

Recent developments in the science of gear cutting have attracted attention, chiefly on account of the introduction of high-speed gearing in the driving of ships, both mercantile and naval, whereby the lightness and economy of a high-speed turbine can be combined with the efficiency of a low-speed propeller.

There is, however, another field which offers great possibilities for the use of gears in combination with turbines, viz., the driving of direct-current generators. Certain mechanical and electrical difficulties, which will be touched on later, appear to be inseparable from the design of D.C. machines of considerable output and running at a speed approaching that desirable for an efficient steam turbine, with the consequence that up to the present D.C. generators have either been driven by reciprocating engines, or, if turbine driven, have been subject to undeniable limitations in speed or output, or in both.

The D.C. generator is essentially a moderate-speed machine, and does not lend itself readily to construction for the high speeds of steam turbines. At the low speeds of gas and oil engines, both direct and alternating-current generators become large and costly for their output, and a good efficiency

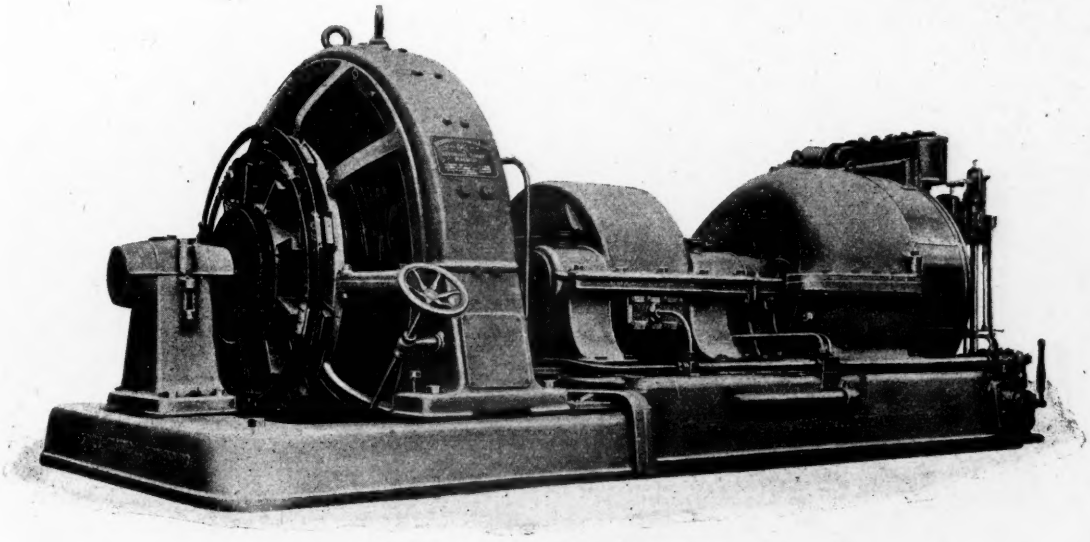


Fig. 1.—B.T.H. Geared Turbo-generator.

can only be obtained by further adding to the cost. At the moderate speeds of so-called high-speed steam engines and motor-generator sets conditions improve, and sound, high-efficiency machines can be designed without difficulty.

In building direct-coupled D.C. turbo-generators, mechanical difficulties arise in the construction of the commutator, in securing the armature windings, and in arranging that the running speed shall not be near the critical speed. Electrical difficulties arise on account of the high reactance voltage of the coils undergoing commutation and high voltage per commutator segment. To ensure satisfactory operation a field structure with compensating windings is usually employed, and the consequent extra excitation losses, together with the rapid increase of core loss, friction, and windage at high speeds, reduce the efficiency considerably in spite of reduced armature copper and shunt field losses. The compensated field construction also considerably increases the cost and the time required to build a machine.

As typical commercial efficiencies for the three types of generators, we may take 91 per cent. for a 250-KW. 440-volt low-speed machine, 93.5 per cent. for a moderate-speed machine of the same rating, and 89 per cent. for a generator running at steam turbine speed. The reduction gear would have an efficiency of about 98 per cent., which gives 91.6 per cent. as the combined efficiency of the generator and gear.

Geared turbo-generator sets can now be built for practically

any output to compete in cost, efficiency, reliability, and floor space with either turbo-alternator rotary equipments or reciprocating engine sets.

As indicated above, the gear-driven generator is built on normal lines, and therefore calls for little detailed description. Being designed to run at a fairly high speed, so as to keep the cost of gear and generator at a minimum, all details of design require careful attention.

The practice followed by the British Thomson-Houston Co. to produce a sound, highly efficient, moderate-speed generator may be outlined as follows:—

Thin laminations of special steel are used for armature core and pole faces to reduce the core loss, as the frequency of the armature currents before commutation will be 40 to 50 cycles per second. Armature clamping bolts which pass through the core are insulated to reduce eddy currents. The air gap is made longer than would be the case with a low-speed machine, so that the distortion of the main flux caused by armature reaction is reduced.

The commutating poles are so designed that over the whole working range from no load to the guaranteed overload the commutating flux is practically proportional to the load on the machine. The commutating-pole air gap is adjusted on test so that the reactance volts of the coils undergoing commutation are exactly neutralised. Diverters across the commutating-pole windings are not used, as, although they form a convenient method of test adjustment, the amount of current diverted is apt to vary on account of changes of resistances due to temperature and variation of the resistances of connections, which in the case of low-resistance windings may form an appreciable item. Also, on varying loads, a plain diverter will not take a uniform share of the current, as its inductance is very much less than that of the winding. Inductive diverters are difficult to adjust and are not satisfactory.

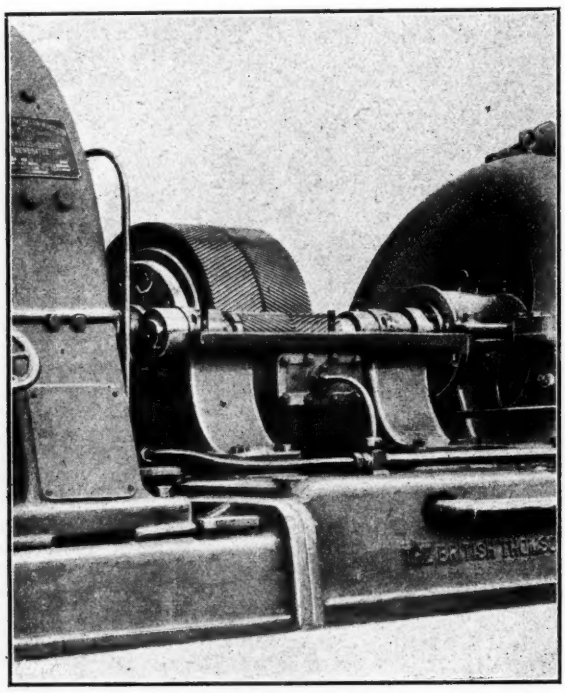


Fig. 2.—View of the Gearing, B.T.H. Turbo-generator.

Even when adjusted to operate perfectly up to heavy overloads, commutating machines are always liable to flash over on heavy short circuits. To minimise the risk of flashing over and to reduce the damage caused by a flash, the clearance between adjacent brush brackets should be kept a maximum and the space between the commutator and the bearing should be kept free from bus rings or earthed metal parts, as the flash always tends to spread outwards from the machine. Reference to the accompanying illustrations will show that the B.T.H. design of brush gear fulfils these requirements.

A substantial brush yoke supported from the magnet frame, brush springs designed to prevent brush chatter, and a carefully balanced armature, eliminate the mechanical causes of unsatisfactory commutation. Graphite brushes reduce the commutator loss to a minimum and rapidly produce a hard polished skin on the commutator, the wear of which is very slight.

Equaliser rings fixed in an accessible position at the back of the armature prevent unbalanced magnetic pulls and equalise the distribution of the load between the several paths through the armature, which is, of course, parallel wound. The choice of a suitable speed and number of poles limits the volts per bar to a reasonable figure. The armature windings are secured against centrifugal force with an ample factor of safety by means of fibre wedges in the slot portion and steel wire binding bands on the ends.

A set recently installed by Mr. Cameron Gibson, the borough electrical engineer, in the power station of the Nuneaton Corporation is an interesting example of a gear-driven set. It consists of a B.T.H. shunt-wound generator having a normal output of 1,500 amps. at from 470 to 500 volts, driven through double-helical gearing by a B.T.H. Curtis turbine of 750 kw. normal capacity. The set has an overload capacity of 25 per cent. for two hours and 50 per cent. for five minutes. The complete set has been constructed by the B.T.H. Co., and the turbine is of their standard three-stage design, as used for driving alternators, and runs at 3,250 r.p.m., the gearing reducing the speed to 600 r.p.m. for the generator. The turbine drives the pinion shaft through a double claw coupling, which allows the pinions to take their correct axial position without any end thrust being transmitted to the turbine shaft. The armature spider is bolted direct to a large flanged coupling on the low-speed shaft, the bearings of which, consequently, carry a portion of the armature weight.

The gears and bearings are completely enclosed, and have a copious supply of oil from the main oil-pressure system of the turbine, which also operates the servo-motor of the governor gear. A return pipe from the bottom of the gear-case leads the oil back to the main oil tank, whence the oil pump on the turbine delivers it through an oil cooler back to the supply pipes.

This set was put on commercial load in January of this year, after exhaustive tests in the shops of the B.T.H. Co. had proved that the guarantees were fully met, and the completely satisfactory manner in which the set has behaved since its installation has given all concerned perfect confidence in the future of this combination.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Electric Heating Resistors.

In the *Electrical World* an abstract of a German article is given in which the author describes heating resistors produced by the Schoop "spray process." The metal which is to be sprayed passes in the form of a ribbon through a pistol in which it is melted and shot out in spray form on to the surface which is to receive the deposit. One method of application is to cover a plate of clay, porcelain, slate, &c., with a thin film of metal by the spray process and then saw cross lines out of the metal film, as shown in fig. 1. These lines start alternately from one side and from the other side, but do not pass all the way over to the other side. In this way a continuous zigzag ribbon is obtained, as shown in the illustration. The connections are made at the points + and −. Another method of application is to produce this resistor ribbon not on plates but on hollow cylinders, as shown in fig. 2, where *a* is the ribbon and *b* represents the underlying clay tube. This resistor is particularly applicable for heating rooms. Through holes in the bottom, cold air enters into the interior of the cylinder; it is heated inside the cylinder and rises upward so that fresh cold air flows in at the bottom. A third method of application is to produce metallic resistor ribbons in artistic forms directly on the tiles of bathrooms, kitchens and other rooms. If at any point such a ribbon resistor is not thick or broad enough, the deficiency can be easily remedied by the spray process.

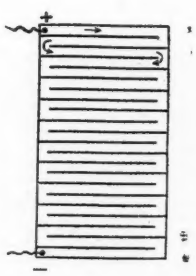


Fig. 1.—Plate Resistor.

Fig. 2.—Spiral Resistor.

New G.E.C. Mining Telephone.

The General Electric Co., Ltd., of 67, Queen Victoria Street, E.C., has recently put on the market a flame-proof and watertight telephone known as the G.E.C. magneto mining telephone K 8098 (1915 type). The case is of cast-iron, the joint between the case and the lid being made by machined flanges 1 in. wide. When the lid is bolted to the case, the joint is both watertight and flame-proof—*i.e.*, any escaping hot gases are so thoroughly cooled in passing between the flanges that they cannot possibly ignite an

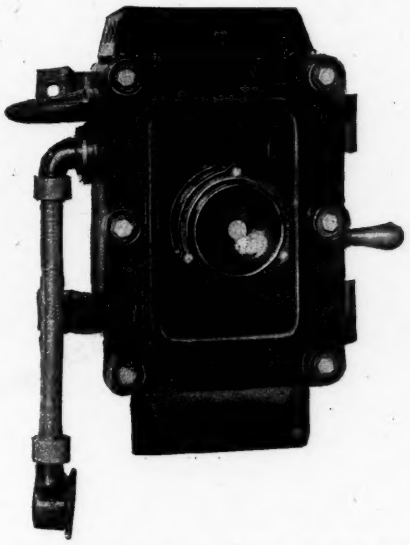


Fig. 3.—New G.E.C. Magneto Mining Telephone K 8098 (1915).

explosive mixture outside the case, even in the unlikely event of an internal explosion. The entire equipment is of high standard, and is manufactured by the Peel-Conner Telephone Works, Ltd., of Salford. The internal unoccupied space is kept down to a minimum so as to limit the amount of explosive gas which might accumulate.

The telephone equipment comprises:—A four magnet tropical type generator, with the armature wound to a resistance of 300 ohms, and fitted with a very strong handle working through a flame-proof and watertight gland; a polarised bell movement fitted with two 3-in. bell gongs, protected by an iron cover; a long-distance speaking, solid-back, transmitter fitted in an iron chamber on the front of the lid, the diaphragm of which is protected by brass gauze; an induction coil; a double-pole "Bell" receiver fitted inside the instrument, the diaphragm end being

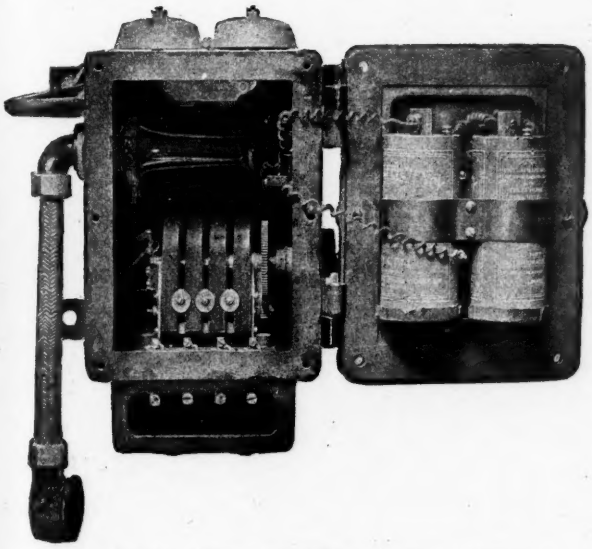


Fig. 4.—G.E.C. Mining Telephone, showing Internal Arrangements.

fitted with a cam arranged so as to revolve when the listening tube (which is placed on the left-hand side of the instrument) is lifted to the ear; the cam is fixed on to the receiver and revolves with it, thereby pressing together a bank of springs which control the primary and secondary circuits; the gland through which the tube passes is flame-proof and watertight; also two G.E.C. dry cells fitted on the inside of the lid.

Attached to the bottom of the cast-iron case is a chamber which contains line terminals, and lugs are provided for fixing.

All mining requirements are met in the best possible manner and all Home Office regulations are complied with.

"Ediswan" Circuit-Breakers.

The Edison & Swan United Electric Light Co., Ltd., of Ponder's End, Middlesex, have for some time past specialised in circuit-breakers, and a recent pamphlet (No. A3112) gives particulars of types "W" and "E." The former, illustrated in fig. 5, is built for currents of 150 to 6,000 amperes, the mechanism consisting of a substantial toggle movement, with loose handle so that the breaker is free to operate electrically even though the handle is held. The breaker is designed to clear all ordinary arcs without assistance from the magnetic blow-out; a wide, quick break is arranged and the magnetic flux for the blow-out is excited

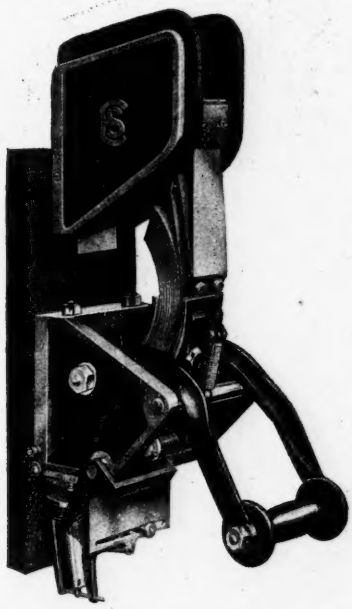


Fig. 5.—"W" Type "Ediswan" Circuit-Breaker.

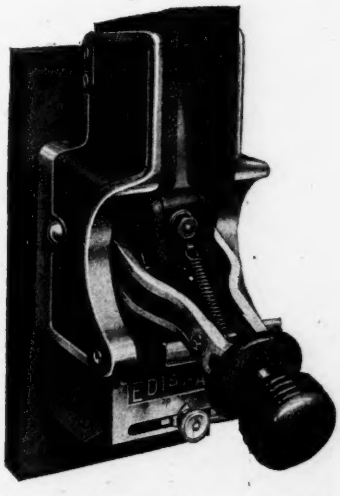


Fig. 6.—"E" Type "Ediswan" Circuit-Breaker.

by the flow of current to the auxiliary contacts, no winding of any sort being used.

The contacts have a wiping action, and the catch is external, and can be adjusted at any time.

The breakers are fitted with time limit, reverse, overload and no-voltage releases as required, and built in single and double-pole patterns.

The "E" type circuit-breaker, figs. 6 and 7, is made for currents up to 350 amperes at 600 volts and in both open and enclosed patterns, an explosion-proof case being provided for colliery work. Constructionally it follows generally the previous type, but when enclosed an external handle is fitted.

Time limit, reverse, overload and no-voltage releases can be fitted as desired; the principle of the reverse release used in both the "W" and "E" types of breaker is based on a purely polarity

Fig. 7.—Enclosed "E" Type "Ediswan" Circuit-Breaker.

effect, which gets over the difficulties often associated with the differential winding system in the event of quick and heavy current reversals.

LEGAL.

Hamilton v. Marconi's Wireless Telegraph Co., Ltd.

(*Concluded from page* 138.)

Mr. Pollock, in summing up the defendants' case, said that the dismissal took place on January 13th, 1913, and the contract of May, 1910, between the plaintiff and the defendant company, ran for the definite period of three years, and so would have continued until May, 1913. The agreement was, according to the verdict of the jury, improperly broken by the defendants in January, 1913, and they were asked by the Judge to give damages in respect of the pecuniary profit Mr. W. Hamilton would have received if he had not been improperly dismissed, and they gave him, in respect of the first period, a sum of £640. There was evidence before the jury, and it was admitted that in respect of that period there was certainly a sum of £140 payable to him, but by reason of an order that had been made, and an agreement between Sir Edward Carson and Mr. Duke, it was contemplated that there would have to be a further inquiry as to damages. Therefore, it was known to the jury and all persons at the trial that at the time £140 was put forward it might not be the full sum which would be payable in respect of the broken period. It was fair to say that no jury could have at that time believed or supposed that there was finality in the £140. They must have taken that £140 coupled with the position which they knew existed—viz., that an account had to be taken. Mr. Justice Avory at the trial directed the jury that the plaintiff was entitled to damages for loss sustained by breach of the agreement and for pecuniary benefits which he might have derived from the agreement; and, further, that he was entitled to such sums as they thought he might have earned up to May, 1913. The jury estimated that sum at an additional £300, and he submitted that that closed the matter in respect of the period from January to May. Plaintiff could not be given any further sum unless it could be shown that the business done during that period overtopped that amount. The inquiry had, on the contrary, shown that he was not really entitled to the £300. The award represented a concluded matter, and, in addition to that, he had got the sum of £1,700 in respect of the value of the chance that the agreement should have continued for another three years down to 1916. He asked the Court to find that over the two periods the plaintiff had been compensated, and that for the further three years he had also been compensated by the sum awarded by the jury, and if the plaintiff asked for commission on sales effected between the periods of January and May, 1913, he was asking to be paid his commission twice over. The agreement was determined by a period of three years, and the plaintiff was to be paid 5 per cent. on the gross value of the sales in return for services rendered and his giving exclusive attention to the business of the company, therefore the agreement could not be for the period of his natural life. He was only entitled to be paid for the period during which the agreement was running. The claim in relation to the high-power stations, or the Imperial wireless exchange, said counsel, rather startled him, because when he looked at the agreement itself, it appeared he was to be paid on the sales effected by the company, as and when such payments became due and payable, and when the amounts were received by the company. The fact was that no money had been received in respect of those stations. The plaintiff then said he was entitled to be paid, because if the contract had not been abandoned there would have been a prospect of his being paid. It was impossible for an agent to charge his principals with a breach of agreement if they found it necessary to withdraw in order to get better terms. As to the claim in relation to the sale of the Amalgamated Wireless Australasian Co., Ltd., he said that it was a claim prompted by an over-sanguine spirit, which did not really know what the true facts were. There was a rivalry existing between the Berlin Co. and the Marconi Co. and the German Co., worked in Australia through the Australian Wireless Co. The rivalry became acute, and it was determined to try to put an end to it. The agreement of March 6th, 1913, was accordingly entered into—an agreement which contemplated taking over the German Co. and the Australian Co. by a new company to be formed. The intention was to take over the business as from October, 1912, which was after the agreement of the plaintiff had lapsed. That sale to the Amalgamated Co. was not a sale which was contemplated by plaintiff's agreement. As to the shipping contracts with the British India and Shaw, Savill lines, he contended that the plaintiff had no claim which could be substantiated. The evidence showed that those companies were fully alive to the importance of having the Marconi wireless, and after the evidence if was impossible to say that the contracts with those companies were secured by the plaintiff.

Mr. Hewart, K.C., in summing up the case for the plaintiff, repudiated the suggestion that the plaintiff was seeking to recover damages to which he was not entitled. The plaintiff was wrongfully dismissed from his position as agent, and in respect of that dismissal he claimed damages, and in addition certain sums to which he believed himself entitled under his agreement as money earned. But, unfortunately, the books and documents were in the possession of his employers. He had no access to them, and when he came to close quarters he was bound to a certain extent to go upon such information as he had, which in many respects was necessarily imperfect. The position taken up by the defendant company was that they did not owe plaintiff a single penny, but when they delivered their defence, they admitted owing him £117. Then, towards the end of a long trial, the defendants admitted that they owed Mr. Hamilton a further sum of £140, bringing the total up to £257. Again, at a late stage of the proceedings, the defendants admitted that they owed another sum of £432 odd; so that up to that point—the last stage of the proceedings—it was admitted that the company owed Mr. Hamilton £689, and, in the course of the present inquiry, it appeared that they owed him a further sum of £30 in respect of a steamship. Under these circumstances, it did not come with a very good grace for the defendants to speak of plaintiff approaching the question of damages in too sanguine a mood, or that he was asking for damages which existed only in his imagination. As to the claim for commission on the three Australian destroyers under the agreement of May 19th, 1910, if the defendants were liable it was not denied that the amount of their liability would be £103 15s. But it was said on behalf of the defendants that they were not liable at all, inasmuch as the contract out of which the sale arose was antecedent to May 2nd, 1910, the date from which the plaintiff's agreement ran. He submitted that the position which the plaintiff had taken up was a right one as the terms of his agreement was "on sales effected," and he submitted that the true date of the sale was that at which the agreement was reduced to writing, which was subsequent to the date of the plaintiff's agreement with the company. As to the sale of the four field sets to the Australian Government: What now appeared was that plaintiff had never received any commission on those four field sets, and that the order was given for them on January 25th, 1913. It was also common ground that if the defendants were liable in that case they were liable to pay the sum of £120, and the contention he had to meet was the contention as to the broken period between the time he was dismissed and the time his agreement for three years was to come to an end. There had been an order made in the action in March, 1914, reserving all questions of account, and it was after, and subject to, that order that the trial before the judge and jury took place. What happened was that towards the end of that inquiry a document which they now knew was prepared by Mr. Cappalare was to some extent made use of and was handed to the judge, and it appeared that for the period from January 13th to May 2nd the defendants admitted that payments had become due to the plaintiff to the amount of £140. They knew now from Mr. Cappalare that if the document had been explained by some one who understood upon what basis it had been drawn up, it would have been impossible to state as a fact that the sum of £140 and no more was what was due to the plaintiff in respect of the broken period. That figure being before the jury, it was no doubt taken into account by them. The question of what was really the total due to the plaintiff was never before the jury. On the question of royalties, counsel said, the facts were not in dispute. What happened was that certain battleships of the Australian Navy were constructed under the supervision of the British Admiralty with Marconi's wireless telegraph installed by the Admiralty. He submitted that it was actually a sale of the right to use the apparatus, if not a sale of the apparatus itself. Those ships were installed before January 9th, 1913, and he submitted that the royalties were part of the price. They were really deferred instalments of the purchase price. The plaintiff undoubtedly did much work in connection with the Australian business, and that high power stations were part of the work was not disputed. The evidence was that in 1910 he went to South Africa and Australia, and put the question of the wireless chain before the authorities, and had otherwise taken an important part in connection with it. When the contract was made between the Marconi Co. and the British Government, Pretoria and Singapore were included. Those stations were to cost £60,000 each, and were expected to yield royalties of from £4,000 to £30,000 a year. Th

plaintiff's submission was that he, acting as agent on behalf of his principals, had done his part fully in the matter, and had succeeded. The contract was made, and in February, 1913 it was repudiated by the defendants themselves of their own choice, and the point was that when the plaintiff had performed his part, and the contract went off because of repudiation by his principals, the claim against the principals was a good one. He submitted that under those circumstances the plaintiff was entitled to the commission which he would have received had the contract been carried out.

The Referee: Had he gone so far that they were certain to get the money? They had a contract which was subject to the approval of the House of Commons, and the contract was not completed until it had been approved?

Mr. Hewart said it would be no part of the plaintiff's duty to secure the approval of the House of Commons. The defendants had wrongfully repudiated the contract, and therefore the plaintiff was in the same position as if they had received the money. Referring to the claim relating to the British India, Burma and Malay States stations, counsel said the contract was that in consideration of plaintiff devoting his whole services to the company, he would receive commission on all sales effected within the territory mentioned. The "all," he contended, covered any limitation as to time.

The Referee: The agreement says that he shall give the whole of his services exclusively, and that points to the fact that it was intended to limit it to such time as he remained giving his services, and that was for a period of three or six years.

Mr. Hewart said that what was contemplated at the time the agreement was made was that the Marconi Co. was to absorb the Pacific Radio Telegraph Co., Ltd., when the plaintiff would be offered the post of managing director. What was intended was that Mr. Hamilton should be their permanent representative, and that he should always receive his commission. In arriving at a decision, the Referee would have to consider the agreement as a whole.

Mr. Verey on Saturday, July 31st, delivered judgment. He said that by the order of Mr. Justice Avory, in the King's Bench Division, he had been called upon to take an account in the case of Mr. Hamilton's claim against the Marconi's Wireless Telegraph Co. The plaintiff claimed that in breach of an agreement of May, 1910, the defendants had not paid him 5 per cent. commission on sales within his territory, and that they had not paid him, as agreed, £10 per ship in cases where contracts for the installation of wireless had been obtained through his instrumentality. He also claimed 5 per cent. on all sales in South Africa. The defendants had paid into Court with an admission of liability £482 and £600, but they denied liability in respect of all claims except those admitted. The commission claimed in respect of the three Australian destroyers involved the construction of the agreement of May, 1910, between the company and the plaintiff, which said that the plaintiff should receive a commission of 5 per cent. on all sales within his territory, and the question was as to when the sales were effected. The order was given before May 11th, 1910, but the actual contract in writing was not signed until after that date. He had come to the conclusion that the sale must be regarded as having taken place at the date of the contract in writing, and he found that the sales in question were effected during the term of the plaintiff's employment, and that he was, therefore, entitled to recover commission upon them to the amount of £103 15s. As to the sale of the four field sets for the Australian Government, the order was given during what had been termed the broken period prior to May, 1913, and for the defence it had been contended that the jury had dealt with that claim in the sum of £640. After careful consideration of the arguments and the observations of the judge, he came to the conclusion that the jury had not dealt with that matter, and that he would have to take account of what was due to the plaintiff in relation to it. As the sale of the field sets was effected between January and May, 1913, the plaintiff was entitled to his commission on it. The defendants said as to the Australian battleships that that matter came within the agreement with the Admiralty, and that no royalties were paid, but he came to the conclusion that the payments to the defendants did not come within the agreement of 1903 with the Admiralty, and he found that the plaintiff was entitled to his commission to the amount of £157 10s. The claim in relation to the high-power stations was made under the agreement of July 19th, 1912, which provided for commission on all sales effected, and the plaintiff said that commission was due to him on a large sum which, he said, the defendants would have received in respect of stations at Pretoria and Singapore had they been erected. As a matter of fact, no stations had been erected, but the plaintiff contended that the defendants wrongfully repudiated the agreement and so prevented the receipt of the money upon which the plaintiff would have been entitled to commission had not the agreement been repudiated. The contract of January 16th, 1913, required to be ratified by the House of Commons, and until that was done the plaintiff was not entitled to receive the money. There was here a contract which enabled the defendants to receive the money even if there had been no default on their part. He found it had not been proved that if the defendants had not repudiated the contract the ratification by the House of Commons would have been obtained. It had not been proved that the repudiation was the cause of the ratification not being obtained, and upon the whole of the evidence he found that the plaintiff had failed to prove that he was entitled to the commission as claimed. As to the claim for damages for breach of contract, he had to consider what were the chances of the defendants obtaining the ratification and receiving any money, and what commission the plaintiff had lost. He found on consideration that the plaintiff had not suffered any damage. As to the sale to the Amalgamated Wireless Australian Co., the plaintiff's agreement provided that if the defendants should create a company to take over the business, the plaintiff should be offered the post of managing director. The arrangement, in his (the Referee's) opinion, was that there should be an amalgamation of the Australian businesses so as to avoid competition; that there should be a taking over of the old business by a new company. The actual transfer was dated November 12th, 1913, and it was provided that the profits under the new arrangement should date from October, 1912. The plaintiff contended that the date was immaterial, because it was intended that his commission on the sales should be for life; as to the claim for life, the agreement provided that the plaintiff was to be sole agent, and that his appointment should be for three years subject to determination in May, 1911, and that should business be satisfactory there might be a continuation for another three years; it was further provided that in consideration of the services he was to render to the company and in consideration of the fact that he was to devote his whole time to the benefit of the company, he should receive his commission. In his opinion, when the consideration, which was to give his services, ceased, the agreement to pay the commission ceased. On the construction of the agreement he found the plaintiff was not entitled to commission on sales effected after May 2nd, 1916, for which period the jury had given him damages. On the whole of the evidence he found, whether the date of the transfer were taken at 1912 or 1913, that the transaction was not such a sale as was contemplated by the agreement, and plaintiff was not entitled to any part of the commission which he claimed. Next, there was the question of the shipping contracts, and he decided that no commission was payable in respect of the Union Steamship Co., of New Zealand. As to the British-India and the Shaw, Savill Companies, the question was, did plaintiff secure the contract, and was he accordingly entitled to his commission on the transaction? After carefully studying the evidence in relation to that matter, he came to the conclusion that plaintiff had not proved that he secured those contracts, and he was, therefore, not entitled to commission upon them. As to the New Zealand warships, it had not been proved that the defendants received any money in respect of them, and the plaintiff was, therefore, not entitled to commission. The same observation applied to the Malay States and the Australian Navies. The claim in relation to the British India, Burma and Malay States stations depended upon whether plaintiff was entitled to commission for life, and as he was not entitled for life he was not entitled to commission in that case. On the whole, he found that the plaintiff was entitled to £482 8s. 11d. and £411 5s., which was more than covered by the amount paid into Court. The judgment of the King's Bench Court provided that the plaintiff should recover the costs of the action, and it was, therefore, not for him to deal with the question.

The Referee intimated that he would report his finding to the judge, and that in his written report he did not propose to say anything about costs.

Compensation Case.

A settlement was intimated in Dunfermline Sheriff Court, on Monday, July 26th, of a compensation action at the instance of the widow and relatives of a labourer against Messrs. C. E. Taylor and Co., electrical engineers, Crombie Ordnance Works. The labourer was killed in December last by an overhead crane falling upon him. Pursuers sued for £195, and have accepted tender of £100.

An Australian Customs Claim.

The *Melbourne Age* reports a reserved judgment, delivered on June 12th, in the High Court, respecting a claim by the Collector of Customs for Victoria. Our contemporary states the details as follows:—

Plaintiff in the original action was Ralph Sadlier Falkiner, trading as the Falkiner Electric Co., in Melbourne and elsewhere, and defendant was Percy Whitton, the collector of Customs for the State of Victoria. About November, 1913, plaintiff imported into Victoria a motor-car, with two benzine motors, each 100 to 120-h.p. capacity, and one double-dynamo chassis and ten electric motor-wagons chassis, with certain accessories. These were all manufactured in the United Kingdom. A dispute arose between plaintiff and defendant as to the rate of duty payable in respect of the goods. Defendant contended that the motor-car chassis was dutiable as a locomotive traction or portable engine, and that the wagons chassis were dutiable as vehicles n.e.i. Plaintiff asserted that the motor-car chassis and the wagon chassis were only dutiable as the chassis of motor-car lorries or wagons, and that the accessories were dutiable as vehicle parts n.e.i. Defendant demanded the sum of £871 as duty in respect to the motor-car chassis and accessories, and £3,720 as the duty in respect of wagons chassis. Plaintiff, on July 10th, 1914, paid the duty under protest. It was alleged by plaintiff that the duty legally payable in respect of the chassis amounted to the sum of £634 only, and in respect of the chassis £39, and proceeded against the collector of Customs for the recovery of £3,917, as part of the sum paid under protest. The action came on before Mr. Justice Hood, who, on December 16th, 1914, gave judgment for plaintiff for £3,917. Against this decision the collector of Customs appealed, on the ground that it was wrong in law.

Mr. Justice Isaacs said that the burden rested with the plaintiff to prove "the contrary" to what the collector of Customs asserted, that was, that the sum claimed was not legally claimable. The only question at issue was: Had more money been paid into

the public revenue in respect of the goods than the law required? Plaintiff's case was that the articles were within the item which read: Chassis of motor car, lorries and wagons, *ad val.*, 5 per cent." If they were, plaintiff succeeded; if not, he failed. According to the strict construction of plaintiff's pleading, the Court would have to regard each of the vehicles as a whole, that was without considering the frame as a separate article from the body. Plaintiff's argument besides claiming the vehicles themselves as a car and wagons had also treated each frame as being separate, as if the particular body with which it came were detached legally as well as mechanically. The parts were in fact and reality separately imported, and the possibility of future combination was not a matter which the Customs could insist on. But, on the other hand, if in truth a complete machine were imported by the same person, at the same time, though its parts were disconnected for convenience or otherwise, his Honour was disposed to the view that the Crown could properly regard the importation in its integrity, as that of the one machine, and claim duty on that machine. His Honour was of opinion that the appeal should be allowed.

Mr. Justice Higgins, Mr. Justice Duffy and Mr. Justice Rich concurred.

The Chief Justice delivered a dissenting judgment, in which he thought the appeal should be dismissed.

The appeal was allowed by a majority decision, with costs.

WAR ITEMS.

Berlin Traffic Conditions in War Time.—The influence of the war has had an appreciable effect upon the passenger traffic in the German capital. During the first half of the present year the decline in the receipts of the Grand Berlin Tramways Co. and its associated undertakings amounted to 6·9 per cent. as contrasted with the corresponding half in 1914, and the decrease in the case of the Grand Berlin Tramways Co. alone was 6·4 per cent. On the other hand, the Underground and Elevated Electric Railway Co. experienced a diminution of 25 per cent., whilst the receipts of the Berlin Omnibus Co. receded by 49·7 per cent. as compared with the first six months in 1914. It is assumed from these figures that traffic has been diverted from the railway and the omnibus services to the tramways, and that the shrinkage in the receipts of the omnibus company is mainly due to the withdrawal of most of the highly remunerative motor-bus lines and the greater use made of horsed vehicles in their place. The tramways company, however, is the only undertaking which has come forward with a proposal for the revision of its fares, which is now before the responsible authorities for sanction or rejection. What is desired is to bring into operation now the right which the company will be able to exercise in 1920 by virtue of an existing agreement with the municipal authorities. It is pointed out by the directors that great caution has had to be maintained hitherto in regard to the use of the 10 pfennigs (1½d.) fare, which has enabled passengers to travel for a distance of over 9 miles, in order to provide a return on the capital invested in the undertaking. So long as the receipts constantly increased, which was at the rate of about 3½ per cent. per annum until 1912, there was an advance in the surplus on working, but the latter declined in 1913 by £41,000 and by £128,000 in 1914. The principal reason for the diminution is attributed to the growth in competition, particularly on the part of the underground electric railway and the motor omnibuses, whilst the higher wages granted in 1911-12 have placed an additional charge upon the company of £50,000 per annum, apart from an augmentation in the interest service on the loans. In addition the cost of materials has risen since the war began, and further expenses have been incurred in grants made to employés and to dependents of employés called up for service, these being estimated at £75,000 per annum. It can already be foreseen that the extra expenses will render the working results for 1915 less satisfactory than in 1914, when a dividend at the rate of 6 per cent. was paid. But two years hence fresh competition will be encountered on the opening for traffic of the A.E.G. high-speed railway and the municipal railway connecting the north and the south of the city, and the extension lines of the Berlin Elevated and Underground Railway. Under these circumstances the company has asked permission to revise the tariff, so that the fares shall be henceforth 10 pfennigs (1½d.) for distances up to 3·10 miles, 15 pfennigs (1·75d.) up to 4·65 miles, and 20 pfennigs (2·35d.) for further distances. It is submitted that the suggested increases would only affect about 15 per cent. of the passengers, that the additional receipts thereby expected would merely serve to defray the higher wages paid during the war, and intended to be continued also in the future period of peace, and that any surplus remaining would have to be divided among the local authorities forming the public purposes union, so that there would be very little left for the tramway company, which would be unable to pay a higher dividend therefrom.

Lighting Supply in the War Area.—The report of the Upper Rhenish Power Works Co., of Mulhausen (Alsace), whose share capital of £1,000,000 is held chiefly by the Municipal Council of Mulhausen, the Zurich Bank for Electrical Undertakings, and the Electric Light and Power Investment Co., of Berlin, states that the supply of energy constantly increased down to the outbreak of the war, when, however, sales were detrimentally affected through the area being comprised within the field of war operations. At the end of the financial year (March 31st, 1915) the number of towns and localities supplied was 216, as compared with 190 on the same date in the preceding year. During the first four months the turnover reached 19,422,000 KW.-hours, as contrasted with 12,389,000 KW-hours in the equivalent period of 1913, but in the succeeding eight months of war the sales were 20,373,000 KW.-hours, as against 32,888,000 KW.-hours, being a total reduction of 5,482,000 KW.-hours for the year. It was impossible to realise economies in working expenses to set against the decline in the turnover, as the supply is based mainly upon the utilisation of water power in connection with which the cost of production changes but little even when the output is considerably decreased, whilst at the same time the other working expenses were increased through the difficulties of transport and the higher cost of materials. The gross profits declined from £73,000 in 1913-14 to £40,000 in 1914-15, and the net profits from £58,000 to £23,000 in the two years respectively. Most of the latter sum has been placed to the renewal fund, this result comparing with a dividend of 6 per cent. in each of the two previous years. The total damage sustained by the plant is unascertainable, as a considerable portion of it is within the fighting area and is not accessible, but the material damage caused in the districts which are accessible is estimated at £25,000.

Russian Platinum.—According to a report received in Basle, Switzerland, from Petrograd, the Russian Minister of Finance has prohibited the export of platinum to neutral countries. The existing stocks of the metal are to be taken over by the Government for use in connection with the construction of Sikorsky aeroplanes.

Tramway Workers and the War Loan.—The Manchester Tramways Committee has been asked by the employés of the department to grant facilities whereby the workers may be enabled to contribute to the War Loan by means of small weekly payments, and the matter has been left with the chairman, the deputy-chairman, and the general manager, with power to deal with it.

Trade Openings Abroad.—Canada.—An engineer in Montreal wishes to secure the representation of United Kingdom manufacturers of power plant apparatus and equipment. Application should be made to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C., for the name and address of the inquirer.

Australia.—A firm in Melbourne is desirous of securing the sole agency for Victoria and Tasmania of a United Kingdom firm manufacturing direct-current and three-phase motors, lamps and electrical goods generally. Communications in this connection should be addressed to the office of the Agent-General for Victoria, Melbourne Place, Strand, London, W.C.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Branch Offices.

In your last issue, Mr. "Erimus" is kind enough to suggest that manufacturers' branch offices are being used as "umbrellas" for shirkers. No doubt Mr. "Erimus" has taken all sides of the question into consideration before rushing into print; if so, I shall be glad to hear his solution of the problem—which is *the* problem of many branch office men—how is it possible to support one's wife and meet obligations out of a separation allowance which would not even meet the rent and rates account? Does Mr. "Erimus" propose that such duties should be neglected, or is he prepared to guarantee sufficient income? If the latter, as soon as the guarantees are satisfactorily fixed up, I can answer for one more recruit.

R. M. M.

August 1st, 1915.

Electrometallurgical Alloys.—The report for 1914 of the Swiss Société Electro-métallurgique Paul Girod, of Neuchâtel, whose investments and works are chiefly situated in France, and whose production is closely associated with the armament industry, shows that the war has exercised an unfavourable influence on the financial results. Not only so, but the convention hitherto existing between the different makers of alloys has been prejudicially affected by the war, resulting in a decrease in orders and causing difficulties in the working of patents. The French Compagnie des Forges et Aciéries Electriques (Paul Girod), whose share capital of £160,000 is held almost entirely by the Swiss company, realised net profits of £22,000 in 1914, as compared with £29,000 in the previous year, but the parent company had had to increase the credit granted to the French undertaking. Since the close of 1914, however, a favourable change had taken place, the credit had been considerably reduced and the prospects of the French company were good. The accounts of the Swiss company indicate net profits of £7,200 on an ordinary share capital of £480,000, and this sum, together with the balance brought forward, and the extraordinary reserve fund of £103,000, has been applied to depreciation, making a total of £131,000 set aside for this purpose for 1914.

REVIEWS.

The Dynamics of Surfaces, by Prof. Dr. Med. LEONOR MICHAELIS. Translated by W. H. PERKINS, M.Sc. London: E. & F. N. Spon, Ltd. 1914. Price, 4s. net.

This small volume is the product of the new school of German scientists. It is characterised by its highly specialised nature. Like most recent Continental productions, it describes exhaustively one very small sub-division of scientific development. The work is intended for biologists, but the matter is treated entirely from the mathematical standpoint, and deals with surface phenomena. There is no doubt that this useful little work will prove of great interest to the more advanced scientists, but it is difficult to believe that present-day biologists will have the necessary mathematical knowledge to take advantage of the information contained therein.

The author states in his preface that the book is intended to summarise the essential points in the theoretical treatment of surface phenomena, always keeping in view the object of applying the knowledge obtained for biological purposes. Although not a biological work, it is intended for biologists, and is written from their point of view. The object of the book is rather to give an account of the principles of surface reactions, so as to enable biologists to deal with such problems more fundamentally than they have done hitherto.

The first chapter introduces the general conception of a surface, and defines the meaning of a phase according to Willard Gibbs. Chapter II deals with the phenomenon of surface tension from the mathematical standpoint, and introduces the idea of surface energy, surface contraction, adsorption, and other physical conditions well known to biologists. Chapter III discusses the electrical forces of surfaces. It introduces the new well-known principles of electromotive force, the conception of the ion, adsorption potentials, and other electrical phenomena characteristic of surfaces.

The book closes with a short appendix devoted to the kinetics of surface reaction. There is both an author's and a subject index. The matter is treated clearly and concisely, and is suggestive of new fields of scientific investigation. The mathematics is of necessity somewhat complicated and difficult to follow, but is not more than is essential. The book as a whole will appeal to students of the later school of physical chemistry, who have some biological knowledge. It will be useful chiefly to those who desire newer branches of research, the treatment being suggestive rather than explanatory.

Elementary Principles of Illumination and Artificial Lighting, by A. BLOK. London: Scott, Greenwood & Son. Price, 3s. 6d. net.

As an elementary book on the subject of its title, this is one of the most successful we have seen, and we believe that the author has completely filled his object as set forth in the preface. Almost without exception the theorems and examples are simply and clearly worked out, so that those whose mathematical knowledge is not very wide, can read and understand all that is put before them.

The work commences with a good synopsis of the contents, and it is worthy of note that Mr. Blok introduces at the outset an index to the tables, symbols, and equations contained in the body of the book. In the first chapter the nature of light is stated in a manner which we would recommend to many of those who endeavour to instil into others an understanding of the subject, for the simple language employed leaves no room for doubt. In this chapter is included an account of radiation, and we do not remember having seen the question of colour treated so well as here, save in a voluminous American work. In a natural sequence units and standards are next considered. We think that the author's comparison between a watering hose and illumination is most unhappy; though well-meaning, it by no means conveys the correct impression. The mathematical dissertation, however, is good until we come to the definition of the lumen, which is slightly involved. The relations between the various units of illumination are well set out in a separate table, and the cosine law is very concisely explained, several examples being carefully worked out in order that there may be no misunderstanding. Intrinsic brilliancy is next treated upon, after which mean spherical and mean hemispherical intensities are dealt with; here the author presents two polar examples, and, unless one is careful, there is apt to be confusion owing to the elevation of one unit being shown alongside the plan of another totally different; but for this the matter is very clear. A description of light standards completes the chapter, and it is disappointing to note that the Fleming Ediswan, and other electric standards are omitted.

The methods and apparatus used in illumination measurements are the subject next dealt with, and we must congratulate the author upon the complete manner in which he has dealt with this portion, the general remarks being especially interesting. The following chapter is devoted to illumination calculations and is worthy of close study, since the subject is treated in a thoroughly practical manner and is not overburdened with the fine mathematical dissertations which one often finds in books of like nature, and which usually count for little owing to the variation of conditions which occur in practice. The examples enable one to appreciate the generalities treated. Point by point and flux methods are clearly dealt with, but we think that the author has been unfortunate in putting forward the carbon filament glow lamp as an example for finding the M.S.C.P., since a student is apt to forget that such a source does not give a symmetrical distribution. We are pleased to find a section devoted to the explanation of the fact that the polar curve is not a flux diagram, a point always difficult for a layman to understand, and often a stumbling block for the beginner. Distinction is also made between total flux and effective flux, but the example on page 80 is somewhat crude and the final statement on that page is open to argument. It is interesting to note that the author displays an example of flux polar paper, which will enable the uninitiated to follow matters more closely. Blok's method of determining flux is also detailed at length. We do not care for the reasoning set forth with regard to the disposition of lighting points as given on the last page of this chapter, especially since it is contrary to proved ideas, and we think that this section could be revised and extended with advantage.

The next section treats upon the derivation of polar curves and contains many novel features. With regard to the radial device described, we would say that we have used a similar contrivance ourselves and found it most effective, provided the supports and framework are well designed, otherwise errors are likely to occur owing to the stresses occasioned by the mirrors; this applies more particularly to a large photometer. We do not understand why the author should find it necessary to determine the reflection constant for the mirrors; it is surely a simple matter to insert a standard lamp in place of the unknown and calibrate the substandard accordingly. This need only be done when checking the substandard and it saves unnecessary labour and avoids sources of error. The chapter on shades and reflectors follows and contains much new and useful information. A visual inspection of many of the polar curves will enable one to appreciate the inefficiency of some of the so-called "globes," especially those relative to gas lighting.

The sections relating to indoor and outdoor illumination are well worth study, but they would not suffer if they were considerably amplified. The properties of illuminants are well treated, and the information relating to gas lighting should be of great service to electrical engineers in view of the frank statements of the author, who evidently quotes from experience. The work concludes with some useful tables and a good index. It is the best book of its kind that we have yet seen and is deserving of a wide circulation.

Wireless Telegraphy, by A. B. ROLFE-MARTIN, B.Sc. London: A. & C. Black. Price, 5s.

This is a work intended for the average student of electrical engineering who is obviously assumed to have a good general knowledge of electrical principles. It consists of some 248 well-printed pages and 143 clearly-finished illustrations. The opening chapter deals with the simpler theoretical principles of electro-magnetic waves and electrical oscillations. The general theory of electric waves is very briefly treated and confined to a few brief statements without any attempt to formulate a concept of the mode of transmission of ether waves through space. Explanations of apparatus and methods of working are aimed at throughout, rather than general principles.

The matter dealt with is, on the whole, judiciously selected, and the theoretical portion is certainly commendably terse and lucid. In particular, the question of arranging and dimensioning the low frequency circuit in transmitters operated from alternating-current power is well explained, though many text books conveniently ignore or gloss over this matter. In the more practical part there would sometimes appear to be a tendency to over-state the effectiveness of devices or methods. For instance, it is not clear on what grounds the Marconi continuous-wave method is said to cover "the only generator which has given satisfactory results in long-distance work." Neither is it considered that the statements made regarding alteration of damping by the opening and closing of gaps in rotary dischargers will bear close investigation.

On the whole, the book can be recommended as a useful and fairly up-to-date one for students.

Reports of Experiments on Tungsten Filament Glow Lamps carried out by the National Physical Laboratory. Part I. and II. 1913. London: Crosby Lockwood & Son. Price, 21s. net.

The results arrived at through the many researches carried out by the National Physical Laboratory are usually of considerable service and of great interest, but we are inclined to think that the report now before us is all too brief, so that it is impossible for one to draw a definite conclusion as to the merits or demerits of the lamps under consideration, save in one particular.

We had looked for an exhaustive treatise that would have aided large buyers. As given, only four makes of lamps can be said to have been tested, since the quantities taken in the other cases are not representative, or, if so, give negative results. Of one of the four, the batches were taken from

lamps delivered to War Office specification, and therefore in only three cases are the tests any criterion of the manufacturers' product. For obvious reasons the makes of lamps are not specified, and from the figures given we are inclined to think that the makers should be grateful. In his report, Mr. Paterson points out that it is inadvisable to draw general conclusions, and, with this admission before us, we do not comprehend why it should have been deemed advisable to make the publication.

The second volume of the report is entirely devoted to the admirable curves and target diagrams which represent the whole of the published results, and they betoken much tedious and careful work, of interest to but a narrow circle.

The first volume contains the text, and the objects of the tests are set out as (*a*) To obtain data as to the degree of uniformity existing at the present time in the individual lamps composing batches of metallic filament lamps of given nominal ratings; (*b*) to obtain data as to the behaviour of metallic filament lamps on life tests, mainly with a view to ascertaining the value of watts per candle on life test which corresponds to a given candle-power drop after 1,000 hours.

With regard to (*a*), the striking point is the unreliability of the makers' ratings, and we are inclined to think that if these tests were repeated now, considerable changes would have taken place owing to the constantly improving methods of manufacture.

Object (*b*) seems to have been more nearly attained, and Mr. Paterson's conclusions are indeed interesting. It would appear that the lamp-makers are very modest when they inform us that the life of the lamps is 1,000 to 1,500 hours, though there are fluctuations in individual performances. The arguments set forth for a proposed life-test specification are very clear, and generally we agree with the reasoning. There is but little doubt that the report has been of aid to the manufacturers, and many of the improvements in quality are due to the work carried out by our National laboratory. We trust that time and money may be found to repeat the experiments and a similar report issued, so that the public and others may gauge the progress made, and draw definite conclusions as to the modern tungsten filament lamp. If this may be done, we would like to suggest that it would be desirable to adhere to the same denoting letters that are used in this report, and, also, we think that all the lamps should be purchased in the open market, where no specification such as that issued by the War Office is in use.

Electricity in Gases, by Prof. J. S. Townsend. Oxford: University Press. 14s. net.

It is noteworthy that text-books on this and allied subjects are tending to become more stable; in other words, there is a greater absence of experimental data haphazardly put together, and a better attempt at synthesis; so that the student is gradually becoming able to obtain a connected or bird's eye view of the many intricate processes involved, and to base his study on fundamental conceptions that render such study intelligible. Another sign of the times is that the Electronic Theory, by reason of the basic ideas involved in it, is being increasingly used by writers; so much so that many text-books until recently regarded as standard, and usually full of irritating problems of no practical use, are already obsolescent.

The present work is the author's contribution to a treatise in six volumes dealing with the electrical properties of gases and the subject of radiation in general; the series being proposed some three years ago by Prof. Marx and conjointly worked out by several well-known physicists.

In this volume the author limits his work to a description of the conductivity obtained in gases at ordinary temperatures and at pressures ranging from atmospheric to those of the order of one millimetre, in which the discharges may be explained by the theory of ionisation by collision; but he includes a brief description of the principal experiments on cathode rays and positive rays obtained in high vacua. It is a large book—some 500 pages—and very little has been omitted in the way of experimental detail relative to its subject. Moreover, the author possesses the faculty of putting the gist of the matter under consideration into just the correct number of words—a very valuable faculty where students are concerned—with the consequence that, though he describes great numbers of experiments, he never commits the fault of wandering into side paths and diverting the reader's attention from the main argument. The subject of electricity in gases is one that requires lucid treatment. So complex is it that experiments very carefully conducted often give most divergent results by reason of the number of variable factors involved. In working out the currents which are generated by Röntgen rays, for instance, it is necessary to take into consideration the secondary rays which are given out when the primary rays fall upon metal surfaces, or when they pass through any kind of matter. The secondary rays are themselves very complicated and consist of groups of rays differing widely in penetrating power. Hence the difficulty of experimental research and of obtaining precise data—a difficulty which is a universal feature of this portion of electrical science.

The author, in his opening chapters, deals with the production and motion of ions in gases, the velocity of ions in an electric field, the diffusion of ions, and re-combination. Thereafter he discusses the determination of the atomic charge. Especially interesting is his account of the various methods for the formation of clouds in gases, and of Wilson's method of making visible the paths of ionising particles in a gas (the latter being accompanied by photographs).

In Chapter VII is found much interesting matter on recent determinations of the charge *e*, Stokes's formula, Millikan's experiments on positive and negative charges, Rutherford and Geiger's determination of the charge on an α particle by a radio-active substance, Perrin's determination of the number of molecules per cubic centimetre of a gas, number of granules in an emulsion, observation of Brownian movement and its theory, and so on. A fully-developed chapter is that dealing with discharges between conductors of various shapes. Some of the subjects considered are brush discharges, discharges between spheres with an account of Baille's experiments, discharge from a point to a plane with Töpler's investigations of point discharges, determinations of sparking potentials with results by Kelvin, De la Rue, and Müller, Baille and Paschen, and Carr, the effects of different gases at various pressures on sparking potential, discharges between co-axial cylinders with an account of Gaugain's experiments, Whitehead's experiments with alternating forces, and so on. The later chapters have to do with discharge tubes, cathode rays, and positive rays.—W.J.C.

OVER-SPECIALISATION.

By JOHN MARKS.

That a man or a firm wishing to succeed to-day must specialise is a freely accepted axiom; but, in the opinion of the writer, it is possible to carry this idea to such lengths that in place of giving a constant expansion to the trade of a firm, it may act as a decided restriction on their earning capacity.

This war has shown up many points in which our firms are wanting, and amongst these points, is that of carrying specialisation to an extreme length. Over and over again requests for articles which have usually been made abroad have been met with the reply: "Oh, that is out of our usual line," even when quite a small amount of accommodation would have enabled the goods to be manufactured in commercial quantities.

The writer has naturally noticed this attitude in the case of his own calling of an engineer; but the opinions of friends in other lines support the contention that our intense national conservatism is holding back our enterprise in a good many directions. Specialisation is absolutely necessary if one is to sell one's products in the open market; that is not contested, but is it necessary at the same time to refuse other lines of business, especially lines akin to our own? Must we always remain men of one idea only, instead of applying our organising talents to the collection under our business premises of two or more lines, each of which is carried out and prepared for the markets by specialists, and then put on their particular markets by men understanding those particular markets' demands?

That this is by no means incompatible with sound business is capable of proof by reference to more than one great engineering firm in this country which handle in a highly successful manner, propositions as wide apart as textile machinery, hydraulic work, and the manufacture of electrical and chemical works plant.

On the other hand, we had the spectacle of one celebrated specialist motor-car firm having to hang up its production for about three months last March, owing to the fact that the season's demands had been more than met at that date. Now, although the partial shut-down did not last the full three months, it was necessary to dispense with several thousand workmen, and it cannot be denied that during the partial cessation of output the firm were not making, but, on the contrary, must have been spending, money.

Another example of this kind which the writer witnessed occurred to a firm with which he was in close personal touch. The firm started as a general engineering works, and got together a really nice trade in general work, and in two or three small lines which were constant and fairly profitable. After a time they entered another field of the engineering trade, largely at the request of an influential agent. This trade was nursed by the agent, and the whole of the clever brains of the establishment were brought to bear on

the problem of turning out a first-class product in the new line of business.

Naturally these combined efforts resulted in a large expansion of trade; the works were enlarged considerably, new plant was laid down to cope with the special line, and all went as well as could be desired. Space being required for the new line, the older and smaller lines were gradually obliged to give way, and two of them were disposed of to another firm.

This state of things continued for quite three years, and then for a period of about five months the special line was very badly hung up owing to a war putting a damper on that particular trade. The trade in the new line had been largely foreign, and in consequence the Home Market had been neglected, and no advertising done; consequently the firm were hardly in a position to claim that they were an accepted firm in that particular line, for they were practically unknown in the Home Market.

Naturally the extensions which had been made to cope with the great increase in the special line left the firm with a heavy standing or oncost charge, whether few or many machines were turned out, and in the period of slackness this was found to be a very heavy charge on the firm's financial resources.

Happily, about this time the proprietor of the old lines, which had been passed on to another firm, signified that he was very anxious for the firm to take up their manufacture again, and offered attractive terms to induce them to do so; this was an extremely fortunate turn of events, and the firm took the chance gladly.

It is to the procedure in this matter, however, that the writer wishes to call particular attention. The mistake was not again made of considering this work as of little value. A draughtsman was put at the head of the work, and given the old staff of men to work with. He was instructed that he was to act as works manager for that particular portion of the firm's products, and that he was to carry out the work as a specialist; that his time was to be devoted to devising the quickest and best methods of getting the work through; that any special tools or jigs he required would be made or procured for him; and that as soon as the foreman and himself had got the matter into a regular swing, he was to see what improvements he could introduce, and to ask for other draughtsmen or clerical assistance as soon as he required such.

This, of course, was simply specialising in that particular line, and merely necessitated a little organisation to put the work into effect.

The results were what had been looked for; better manufacturing than occurred in the previous days, and hence a more rapid output and quicker turnover, as well as an enhanced profit on each machine sold. In discussing the matter with the general manager of the factory some two years afterwards, the writer was assured that never again would the mistake be made of allowing work to go away from the firm. "If others can specialise in it, so can we," declared the manager. "It only requires a little thought and a little intelligent organisation."

He also stated that though the special line had, after its period of slack trade, picked up again as wonderfully as ever, yet they took care to keep the old lines in their own special way quite up to date; adding: "if ever we are slack again in our engine shops this work will always earn a little more than bread and butter, to keep us together until times mend again."

This policy was then supported by advertising in the recognised trade papers, in order to develop the home trade.

Another feature which followed in the track of this policy was that the firm invented special tools for carrying out certain of their engine-building operations more expeditiously.

When these tools had been thoroughly well tried, by use in their own shops on a commercial scale, they laid out special shops and machines, and put the tools on the market, both to their own profit and the benefit of the trade in general. This new department was, however, run by specialists on that particular work.

The proof of the success or otherwise of the policy is found in its results. When the first slump in their foreign trade occurred the firm in question were employing 200 men; within two years of the adoption of the newer policy the number had doubled, and after five years more when the tool department was manufacturing for the general market the employés were over 1,000.

Specialisation we must have, but specialisation which means the stagnation of all talents except one particular set is not the correct policy.

The directing heads of a firm should use their energies and experience in so organising matters, that every department is managed and run by specialists.

THE SUSPENSION OF A CONTRACT.

[FROM OUR LEGAL CONTRIBUTOR.]

There are probably many manufacturers up and down the country who are concerned at the present moment with problems raised by the suspension of contracts. However desirable a multiplicity of remunerative contracts may be in the piping times of peace, there are many reasons why it may be desirable not only to refuse new, but to suspend old, agreements, for a certain or uncertain time. Scarcity of labour, the rise in price of materials, the difficulty of obtaining from abroad goods which are indispensable for the proper completion of the work—all these are factors which may render suspension desirable from the purely business point of view. But other forces, not less cogent, are also at work. Your patriotic employer who desires to devote part of his works to the manufacture of munitions of war may find himself hampered by the necessity for fulfilling his obligations. In the event, however, of a way out being found by amicable arrangement, the energies of his staff may be devoted to the pressing needs of the nation.

The question is: How can a contract be suspended? It may be taken that, generally speaking, it is not competent to either party to declare the contract suspended because of the war. Unless (which is very unlikely) there was a special clause prescribing rights and liabilities on postponement owing to war, the parties must come to an arrangement between themselves. Mutual consent is of the essence of such an arrangement.

To narrow the scope of our discussion, let us consider how best a contract drawn up in accordance with a well-known form can best be varied or modified—noting some of the points which must receive consideration.

Take, for instance, the form of model general conditions for electricity works contracts approved by the Institution of Electrical Engineers. That form provides, by Clause 37, that the purchasers must pay to the contractor "all reasonable expenses arising from suspension of works by order in writing of the purchasers or the engineer, unless such suspension be due to some default on the part of the contractor." The "suspension" referred to in this clause is not the suspension with which we desire to deal, inasmuch as it would be ordered by the engineer and could not, apparently, be decreed by anyone else.

Let us consider some of the more important clauses to see what must be provided for.

By Clause 38 it is provided that "the works shall be completed on the site and ready for beneficial use or for testing by the date named under each section, or by such other date (if any) as may be incorporated in the contract." It is obvious that the suspension of the contract will make it necessary to vary the date of completion. If the completion is originally fixed as by the above clause, it will be necessary to recite, in the suspensory agreement, that the work was to have been completed within so many weeks or months from the commencement of the works and to provide, in the body of the agreement, that "the works shall be completed within —— months of the date of commencement but, in estimating this period, no account shall be taken of the time elapsing between the date of the suspensory agreement and the date by which the engineer shall have given at least one month's notice in writing for the work to be completed." To foresee the date of the conclusion of the war were impossible, and it will therefore be best to

leave the date of completion entirely open—subject to the discretion of the engineer.

Provision must also be made for the covering up and protection of unfinished work, and for the settlement of the question who shall pay for such protection, and who shall be liable for the maintenance of such work during the suspensory period. Further, inasmuch as unfinished work might not fall to be paid for under certificate pursuant to Clause 34, the contractor will probably desire to secure the insertion of a clause whereby unfinished work shall be measured and paid for forthwith.

With regard to materials brought on to the site for the purposes of the works, Clause 27 provides that they: "Shall from the time of their being so brought, vest in and be the property of the purchasers (in other words, the employers) until the completion of the contract." It is conceived that if a suspensory contract is entered into it would be fair to provide that the contractor shall be paid for all materials delivered. Such materials as are not likely to deteriorate can be stored on the site or elsewhere, and provision can be made as to who shall bear the cost of carting, storing and re-carting when work is resumed.

As to perishable materials, *e.g.*, cement, &c., an arrangement must be made under which the contractor shall be at liberty to take them back for use elsewhere, and if he is under contract with merchants to deliver such materials on the site, he must be enabled to cancel those contracts—the necessary compensation being paid either by him or the purchasers in accordance with the terms of the suspensory agreement.

Inasmuch as the contractor will inevitably sustain other losses which cannot be very accurately estimated in money, it may also be necessary to provide for the payment to him of some definite sum to provide compensation for loss of profits.

Another matter to which the attention of those who draft a suspensory agreement must be directed is the change which is nearly sure to take place in the cost of labour and materials. After the lapse of a year or more—especially in war time—the cost of labour and material may be altered to the prejudice of a contractor who is tied down to the original schedule of prices and bills of quantities upon which his tender was based. It should, therefore, be provided that upon resumption of work the prices shall be reconsidered in the rate of current cost of material and labour, and the amount to be paid to the contractor varied accordingly. A final clause would provide that, subject to the terms and conditions of the suspensory agreement the original contract shall remain in full force and effect.

BUSINESS NOTES.

Bankruptcy Proceedings.—John Boult, electrician, 3, Grosvenor Street, Chester.—At the Chester Bankruptcy Court on July 27th, before Mr. Registrar Farmer, the public examination took place of John Boult, 48, Upper Hope Place, Liverpool, and John Hugh Bolt, 6, Pepper Street, Chester, carrying on business together in co partnership under the style or firm of John Boult, at 3, Grosvenor Street, Chester, electricians. The gross liabilities were returned at £620, and were expected to rank for dividend at £605. The assets were estimated to produce £580, leaving a deficiency of £25. The cause of failure, as alleged by debtors, was insufficient capital, the war affecting cash sales at shop, and cost of actions against the firm. The separate estate of Mr. John Boult showed gross liabilities £1,519, estimated to rank for dividend at £1,487. The assets were estimated to produce £801, leaving a deficiency of £686. The cause of failure alleged by debtor was the strike of three months' duration in the summer of 1914, and the war following, with a loss on the Chester business, in which he invested £100. The separate estate of Hugh Bolt showed his liabilities were expected to rank at £50. There was a deficiency of £43. The examination was closed, subject to the usual formalities.

Henry Geo. Wright, 69, Blackboy Lane, Wood Green, N.—An application for an order of discharge was made on Tuesday last week to Mr. Registrar Linklater on behalf of Henry Geo. Wright. Mr. Egerton S. Grey, Official Receiver, reported that the debtor petitioned the London Bankruptcy Court in March, 1912, to avoid a committal order. The provable debts amounted to £392 13s. 3d., and there were no assets in the estate. His Honour granted an order of discharge, subject to judgment for £15, to be paid within seven days.

William Walker (trading as David Smith & Co.).—An order of discharge was made on July 1st, varying the order made on December 15th, 1914, the bankrupt being required to consent to judgment against him for the sum of £1, and costs £1 10s. before his discharge takes effect.

Liquidations.—Spanish National Submarine Telegraph Co., Ltd.—A meeting will be held at 106, Cannon Street, E.C., on September 16th, at 12.15 p.m., to receive an account of the winding up from the liquidator.

Adnil Electric Co., Ltd.—A petition for the winding up of this company, presented by Messrs. A. E. & A. C. Wheeler (Acme Electrical Manufacturing Co., Tottenham), is to be heard on October 19th.

Consolidated Diesel Engine Manufacturers, Ltd.—A first and final dividend of 20s. in the £ is payable on August 17th, at General Buildings, Aldwych, London.

Baldur Engineering and Supply Co, Ltd.—A meeting of creditors is to be held on Thursday, August 12th, at 11 o'clock, at the offices of Messrs. Strong & Bolden, 70, Gracechurch Street, E.C.

Catalogues and Lists.—The Electric and General Works, Ltd., 15, Victoria Street, S.W.—Price list of electrical apparatus, covering switches, circuit-breakers, ironclad switchgear, oil switches, horn-type line switches and lightning arresters, and fuses, in great variety. We are informed that these apparatus are made by a Swiss firm, into the constitution of which no German interest enters, the capital being wholly French and Swiss.

Hotpoint Electric Heating Co., 38, Poland Street, Oxford Street, W.—Folder relating to the new hotpoint grill stove, "El Grilstovo," and the hotpoint irons, which have been reduced in price; also folder describing the "El Rangeo" electric cooker.

Westminster Tool and Electric Co., Ltd., Suffolk House, Laurence Pountney Hill, London, E.C.—Illustrated folder, giving a "Business Chat," relating to the "Westool" electric drill, and a note of prices.

The German Cable Makers' Syndicate.—The syndicate of German cable makers, which on the outbreak of the war was provisionally prolonged to the spring of 1915 and then to the autumn, has again been extended to the end of this year. The chairmanship is continued by Herr Berliner, general director of the Bergmann Electricity Works Co.

Book Notices.—Halifax: A Commercial and Industrial Centre, 1915. London: Sells, Ltd. Price 2s. 6d.

"Wireless Time Signals: Radio-Telegraphic Time and Weather Signals, transmitted from the Eiffel Tower, and their reception." London: E. & F. Spon. Price 3s. 6s. net.

Trade Announcement.—The business of Mr. John Boult, electrical engineer, 3, Grosvenor Street, Chester, is being offered for sale as a going concern.

LIGHTING and POWER NOTES.

Aberdeen.—In June the units generated at the Corporation generating station showed an increase of 108,510 over the corresponding month of last year.

Argentina.—The municipal authorities of Lincoln (Province of Buenos Ayres) and the representatives of the Gasmotoren Fabrik Deutsche Co. have signed a contract, whereby the latter assumes the lease for a term of five years, of the electric light and power stations and the waterworks belonging to the municipality. The leasing company has taken formal possession of these installations. The contract is *ad referendum*, subject to confirmation by the Municipal Council.—*Review of the River Plate.*

Atherton.—Mill Driving.—The new No. 2 Mill of the Laburnum Spinning Co. is almost fully equipped, and the shareholders had an opportunity of going through the place after the half-yearly meeting last week. The mill is electrically driven, the current being taken from the South Lancashire Tramways Co.'s generating station, through the local U.D.C. The B.T.H. Co. supplied the electric motors, and Messrs. John Collier & Co. the cables.

Australia.—The Castlemaine (V.) B.C. has provisionally accepted a tender for public electric lighting for 10 years.

The Shire Council of Korumburra (V.) is extending its electric lighting plant.

The South Australian Railways Commissioner is applying to local undertakings for a supply of electricity for lighting the Wallaroo shunting yards.—*Aust. Mining Standard.*

Bradford.—Year's Financial Result.—The annual statement of the city treasurer, as regards the electricity works shows:—Income, £147,583; working expenses, £71,587; gross profit, £75,996; interest on loans, &c., £24,460; provision for repayment of debt, £32,581; and surplus for the year, £18,955. The expenditure out of loans on the electricity works was £43,838, making the total expenditure on the undertaking £934,284, of which £428,594 represents loans repaid and sinking fund in hand, leaving a net debt on the undertaking of £505,690.

Brighton.—Year's Working.—The report of Mr. John Christie, the borough electrical engineer, on the working of the electricity department for the year ended March last, shows a decreased output sold of some half million units as compared with the previous year, this being due mainly to restricted lighting. The units sold were 10,214,436. The revenue, £93,869, was a decrease of £4,244; working expenses absorbed £50,903, leaving a gross profit of £42,966, and, after providing for capital charges, there was a net deficit of £1,354, as against a surplus of £2,342 in the previous year. The works costs per unit sold were '75d., against '74d.; coal cost more, but more efficient operation reduced the weight per unit to 3·97 lb., as against 4·06 lb. The output for private power, heating and cooking increased by 121,041 units, and bulk supply to Aldrington by 5,000 units, but this supply will probably be transferred to the Hove undertaking shortly. The maximum load was 4,960 kw., and the load factor 23·5; the generating plant capacity was 8,500 kw.

The Corporation Lighting Committee has decided that the following special clause shall be inserted on all official orders for goods issued from the electricity department:—"The condition of this order is that the goods supplied have not been manufactured in Germany or Austria."

Carlisle.—Year's Working.—The result of the last year's working of the electrical undertaking was a small profit of £76, as against £209 loss in the previous year. The war affected the business of the undertaking considerably, although 3,470,492 units were sold, as against 3,140,457 units in the previous year, the maximum load and load factor being 2,018 kw. and 19·6 per cent. respectively, as against 1,944 kw. and 18·45 per cent. The total revenue was £21,404; while the working costs were £13,063 (£1,000 less than in 1913-14), and the gross profit £8,341, compared with £7,161. The benefit of the new turbine plant, recently described in our pages, was not fully experienced during the year, and this will be more than counterbalanced by additional costs this year.

Chelmsford.—Street Lighting.—The T.C. has agreed to a rebate at the rate of £350 per annum from the Electric Supply Corporation's accounts for the period during which the diminished street lighting remains in force. Consideration of the account for the year ended June 30th has been adjourned until a report has been received upon negotiations with the Electric Supply Corporation regarding the payment, if any, for the period for which the whole of the street lamps remained extinguished.

Chester.—Year's Working.—The annual report of the electricity undertaking for the year ended March 25th last shows that the gross profit was £12,483, and the net profit, after meeting financial charges, was £3,194; £6,933 had been contributed out of revenue to the capital expenditure; £1,118 to the lamp rate; and a balance of £1 358 carried forward. The auditor's report states that after debiting interest and sinking fund charges on loans, and the revenue contributions to capital expenditure, and allowing '632d. per unit for the sale of electricity generated at the hydro works, the surplus for the year was £2,974.

The T.C. has decided to purchase three electric 2-ton wagons for the removal of refuse, the cost being met by four annual payments of £800. It was stated that this mode of traction would result in a saving of £124 a year over the system now in use.—*Liverpool Daily Post.*

Dublin.—The small electrical contractors are complaining that the recent order of the Electric Lighting Committee as to rates of charge will have the effect of destroying their business, stocks of electrical goods being left on their hands. It is proposed that some arrangement should be entered into with the Committee.

Ealing.—Price Increase.—The T.C. has agreed to a 10 per cent. increase in the price of current after the September quarter. The engineer estimates that the coal costs during the winter will probably be increased by about £3,000.

Edinburgh.—New Power Station.—The Corporation, on the recommendation of the Electric Lighting Committee, has decided to accept the estimate of £5,727 for the foundations for the new generating station at Portobello; it was stated that in the opinion of the superintendent of works it would take six months to complete the foundations, and in view of their responsibilities it was urgent that they should adopt the recommendation, which came in for considerable criticism.

Erith.—Plant Extension.—The U.D.C. has adopted the proposals of the engineer for the extensions at the electricity works, mentioned in a recent issue of the Electrical Review, and has decided to apply to the L.G.B. for a loan.

Gillingham (Kent).—As there is only a credit of about £200 on the mains and services loan account, the T.C. has decided that no mains extensions be taken in hand, and to reserve the whole of the £200 for services.

Gloucester.—Annual Accounts.—The last year's working of the electricity department shows revenue amounting to £15,562, as compared with £15,125 in the previous year. The working expenses were £7,540, and the gross profit £8,022, compared with £7,616 in the year 1913-14. The net profit was £904, as against £595 in the previous year. The additions to consumers and to the connected load were only about half of the usual average. Of the net surplus £353 has been appropriated to capital expenditure, and £550 has been carried forward, increasing the balance brought forward to £1,305. The output of the works increased by 85,000 units, the sales for power purposes exceeding for the first time those for private lighting and domestic supplies. Having regard to the increase in the price of coal and the payment of a war bonus to the employés, an addition of £1,600 or £1,800 to the working cost is contemplated in the current year, but the question of raising the tariff to consumers has been postponed.

Harrogate.—Extension of Supply Area.—As a result of the recent granting of a provisional order to the T.C., an additional supply area of about 25 square miles of rural district has been obtained, although the order does not come into force until after the war. The compulsory areas are small districts in Pannal, where mains have already been laid under the general Act of 1909, and some 30 or 40 consumers are now being supplied.

Ilford.—The U.D.C. has received the sanction of the B. of T. to the provision of electricity generating plant in association with the refuse destructor.

Irlam.—E.L. Scheme.—Although the prov. order for the supply of electric light has been obtained, it is not expected that the U.D.C. will take any steps to give effect to it until after the war.

Kingston-on-Thames.—Year's Working.—Further increases in the charges for current have been made by the Corporation in view of the heavy deficit on the past year's working of the undertaking. According to the report of the borough electrical engineer, the deficit, after repayment of capital, amounts to £1,295 compared with £720 in the previous 12 months. The net total loss on the whole period of working amounts to £18,119; in the years 1904, 1905 and 1906 only was there a surplus after payment of capital charges. The engineer states that the year's working was obviously prejudicially affected by the war, principally by the compulsory shutting down of all outside lighting. At the meeting of the Corporation last week, Alderman Lyne said the decrease in revenue had been almost entirely in shop lighting. One solution of the difficulties was that they should sell the concern; they could, undoubtedly, get offers in normal times, but under existing circumstances no company could be started to take it over. The additional increased charges were estimated to bring in another £2,088, leaving a deficit this year of £200. During the course of his speech Alderman Lyne said that if all the plant at the works had been driven by oil, they could have reduced the cost of fuel by £1,759, the cost of oil fuel being under ½d. per unit and of coal over 1¼d.

Leyton.—Street Lighting.—The Electric Lighting Committee has decided to allow a rebate of £55 on the public lighting accounts for the December quarter, and a rebate of £65 in each subsequent quarter during the continuance of the present curtailment of lighting.

Llandudno.—Price Increase.—In view of the increased cost of coal, the U.D.C. has increased the price of current by ½d. per unit.

London.—Infirmary Lighting.—The Westminster B. of G. has had under consideration the question of electricity supply at the Union Infirmary, and has directed the clerk to inquire upon what terms the Chelsea Electricity Supply Co. will supply current to the institution, in order to ascertain whether this would not be cheaper than generating electricity at the infirmary. In the meantime, the Committee recommends that the radiant heat plant, now installed, be supplied with current from the Supply Co., as this will mean a considerable saving to the Guardians.

Woolwich.—The B.C. has decided to appoint Mr. J. H. Paul to make an investigation of the corrosion that is taking place in the new economiser installed at the Globe Lane Works. The charge for steam generated from refuse for electricity purposes for the year ended March 31st last has been fixed at £540.

Islington.—Proposed Loan.—The B.C. has decided to at once proceed with the laying of additional mains, in order to cope with the increased demand for energy to factories engaged upon Government work. The cost of the extension is estimated at £9,076, and application will be made to the L.C.C. for sanction to the borrowing of this sum; also to the borrowing of £200 for another cable extension.

Maidenhead.—Price Increase.—The T.C. has, owing to the increased cost of production, &c., increased the price of current for lighting by ½d. per unit, and for power by 10 per cent., from October 1st.

Mexborough.—Year's Working.—The annual statement of the electricity department of the Mexborough and Swinton U.D.C. shows that during the year ended March 31st last, there was a revenue of £6,305 (an increase of £539 on the previous year). The expenditure totalled £3,725, and after the deduction of interest and for sinking fund charges, there was a net profit of £329, as against £1,043 during the preceding year. The units generated were 760,388, as against 635,782 during 1914, and units sold 678,336 against 565,254. The maximum supply demanded was 350 kw. The increased revenue was solely due to a heavy accession in power business, which outweighed the decline in lighting.

Salford.—New Plant, &c.—Application is to be made to the L.G.B. for the further sanction to the borrowing of sums of £867 and £850. The Electricity Committee has recommended the T.C. to waive the condition as to completion of contract in connection with the acceptance of the offer of the British Westinghouse Co. for the supply of a 5,000-kw. turbo-alternator, in consideration of the company agreeing to the incorporation in the contract of Clause 31 of the Model General Conditions of the I.E.E. and further agreeing to treat the contract as a war contract.

South Africa.—Cape Town.—The Electricity Committee of the Corporation estimates the probable loan requirements of the electricity department for the next two years at £75,000, and recommends the Finance Committee to obtain the authority of the ratepayers to the raising of a loan. The heavy increase in the demand for electrical energy for all purposes makes the obtaining of fresh capital for extensions an immediate necessity; notwithstanding the discontinuance of free wiring, 300 new consumers were obtained from January 1st to April 30th last, and during the 12 months ended April 30th, 1,582 new consumers were connected. The electrical engineer, commenting on the growth of the load, points out that there are several propositions maturing, including the electrification of the Salt River works, which will materially add to the consumption of electricity.

Mossel Bay (C.P.)—At a meeting of voters held recently, the municipality was authorised to raise a loan for the purpose of a district lighting scheme.

Southampton.—Electric Vehicle.—The Electricity Committee is to fit up the chassis of the fourth electric vehicle primarily for main-laying work, and the borough electrical engineer has been directed to obtain tenders for various classes of batteries in connection therewith. The L.G.B. is unable to sanction the proposed additional loan for the purchase of a 750-kw. rotary-converter in lieu of the 500-kw. converter, in respect of which a loan was sanctioned in June, 1914.

Southborough.—E.L. Scheme.—The U.D.C. has agreed to the offer of Mr. W. C. C. Hawtayne to accept an inclusive fee of 30 guineas for his services in preparing an electricity scheme for the town, now closed by the inclusion of the district in the Tunbridge Wells Corporation's Order.

Sutton Coldfield.—Proposed Loan.—The Electricity Committee reported that the L.G.B. had refused its consent to the proposal to borrow £2,500 for the purposes of the electricity undertaking; a special report as to the necessity for the loan has been forwarded to the L.G.B.—*Birmingham Daily Post.*

Sowerby (Yorks.).—Street Lighting.—The P.C. has asked the Electric Lighting Co. for a rebate on the public lighting contract owing to restricted lighting.

U.S.A.—Discussing the rejection of tenders for street lighting by gas in Manhattan, Commissioner Williams recently stated that electric lamps are being widely substituted for gas lamps, and in place of 10,000 gas lamps at the beginning of 1915, it is estimated that by the end of the year there will be fewer that 3,000.—*Electrical World.*

Wanstead (Essex).—Prov. Orders.—The U.D.C. has received notification that prov. orders for E.L. are to be applied for by the County of London Electric Supply Co. and the Periander Syndicate. Both matters have been referred to the General Purposes Committee for consideration.

Watford.—New Plant.—The electrical engineer has been directed to obtain prices for switchgear for the library substation; also to purchase three 100-kw. and three 50-kw. transformers, under the existing contract.

The U.D.C. has applied to the L.G.B. for a loan of £1,560 for mains, &c., needed in connection with Government work.

Wirksworth.—E.L. Proposal.—With reference to the application of Messrs. Pullen & Best, of Bradford, inviting the co-operation of the U.D.C. in the formation of an electrical supply company for the district, the Council has referred to the Lighting Committee for consideration the agreements between the firm named and the Masham Council and East Westmorland R.D.C.

TRAMWAY and RAILWAY NOTES.

Australia.—The latest report from the Victorian Railways Commissioners on the working of the St. Kilda to Brighton electric tramway shows that for the quarter ended March 31st the gross revenue was £6,597, as compared with £6,272 in the same period of 1914. The working expenses for these periods were £4,190 and £5,702 respectively. For 1915 the net revenue was £1,687, and for 1914 £570.—*Australian Mining Standard.*

Barrow.—Female Labour.—Last week women conductors were introduced on the local tramway service, with, so far, satisfactory results.

Blackpool.—Electric Water-Cart.—The Corporation has now obtained delivery of its new electrically-driven street watering-cart, which has been supplied by the General Vehicle Co., at a cost of about £1,000. The vehicle battery will be recharged at the destructor works; the tank has a holding capacity of 750 gallons; the machine loaded weighs about 8½ tons; and the throw of the water spray extends to about 7 yd. The streets can be watered by means of the cart at the rate of about 10 miles per hour.

Brierley Hill.—The Brierley Hill, Quarry Bank and Rowley Regis Light Railway Committee has decided to allow the Light Railway Order to lapse, the district now being served by motor-'buses. The cost of securing the order in 1903 was £1,405

Gloucester.—Year's Working.—The accounts of the light railways undertaking for the past year show a total revenue to March 31st last of £17,806, as compared with £18 017 in the preceding year, the average receipts per car-mile being 6 84d., as compared with 6 77d. The total operating expenses were £13,704, and the gross profit was £4,102, compared with £4,136; 4,358,510 passengers were carried.

Halifax.—Figures relating to the working of the Corporation Tramways during the quarter ended June 30th, show that the revenue amounted to £30,242 and the expenditure to £23,911, leaving a profit of £6,331.

Huddersfield.—Female Labour.—The tramways department has started employing women as tramway conductors on the Honley and Sheepbridge section.

Irlam.—It is reported that the question of linking up Irlam and Cadishead with Eccles and Patricroft by electric car is again coming to the fore, and that the Salford Corporation Tramways Committee is understood to be prepared to reconsider the proposal.

A motor-'bus scheme was mooted some time ago, and the U.D.C. granted licences for six motor omnibuses to ply, but apparently the scheme has fallen through.

Leyton.—Having regard to the difficulty of obtaining supplies of tram-rails, fish-plates, steel-tires, axles, gear wheels, and pinions, and the rising prices, the tramways manager has been authorised to purchase a sufficient quantity to bring the stock up to the estimated requirements for the ensuing 12 months.

Manchester.—War Bonus.—The decision of the Committee on the application of employés of the Corporation Tramways for a war bonus makes the following awards:—1s. per week war bonus to employés between 18 years of age and 21 years; 2s. per week to employés aged 21 years and upwards who are in receipt of 38s. per week or less; employés receiving over 38s. and under 40s. are to receive a sum as bonus, which will bring their wages to 40s. The award makes the payment of the bonus run from the date on which the decision of the Corporation to pay a bonus became operative.

Sheffield.—Year's Working.—During the year ended March 25th, the Corporation tramways ran 8,810,252 miles, some 70,000 less, and carried 107,023,195 passengers, or about 3 800,000 more, than in the previous year. The total earned income was £394,531, and the gross profit (after deducting working expenses and £5,706, war allowances) amounted to £147,701. The balance on the year's working, after meeting all usual charges, was £69,939, as against £77,607 the year before, and was appropriated as to £7,882 to street improvements; £30 018 to renewals fund; £2,000 to the special purposes fund; £7,163 to the accumulated surplus fund; and £22,876 in aid of the rates. The tramway power station was transferred to the electric supply department on September 29th, 1914. Under the new arrangement 11,352,349 units were purchased from the electric supply department, and 6,977,426 units generated, the cost being stated as ·646d. per unit, as against ·446d. in the previous year (when the figures related to tramway generating and distributing costs only). The balance of the accumulated surplus fund amounts to £28,134; of the renewals fund, £3,186; of the insurance fund, £2,202; and of the special purposes fund, £928. The accounts include data as to the department's motor-'buses, which ran 369,404 miles, at an average working cost of 7d. per mile, leaving a gross profit of 3·4d., of which financial charges absorbed ·61d., the balance being placed to reserve and renewals. Petrol cost 1·68d. per 'bus mile. The omnibus reserve and renewals funds amount to some £6,900.

Southampton.—Year's Working.—For the year ended March 31st last, the Corporation tramways carried 13,265,715 passengers, running some 1,700,000 car-miles, both figures being in excess of those of 1913-14. The gross receipts were £71.038 and the gross profit £20,732, this comparing with £24 077 in the previous year. After providing for interest and sinking fund charges and allocating £5,000 to renewals, a sum of £5,134 was contributed in rate relief. The depreciation and renewals fund now stands at £14,251.

South Shields.—Year's Financial Result.—The Tramways Committee in its annual report states that the revenue for the year ended March 31st, totalled £39,845, and that after meeting all expenses there remained a gross balance of £14,335; of this sum £8,741 was absorbed by interest and sinking fund charges, leaving a net profit of £5,594, of which £2,400 was allocated to rate relief, and £3,194 to the reserve fund, which stands at £28,337.

West Ham.—The Corporation has been recommended to agree to the transfer of the control of the maintenance of the tramway tracks, from the Highways to the Tramways Committee, and has also been recommended to alter the title "tramways manager" to that of "general manager," and to fix the next two increments to the tramways manager's salary at the rate of £100 per annum instead of £50, as previously agreed.

Wigan.—Tramway Strike.—On Monday, the motormen, conductors, and depôt employés of the Corporation tramways came out on strike, stopping the whole of the tramway service which serves the Wigan coalfield area. The men have already been granted a war bonus of from 1s. to 1s. 6d. a week, but demand an advance of ½d. per hour on the present wages for motormen and conductors, and 1d. for electricians.

TELEGRAPH and TELEPHONE NOTES.

Colombian Neutrality.—Lord R. Cecil, in answer to a question in the House of Commons with regard to the neutrality of the Colombian Government and the question of the wireless telegraph station at Cartagena, said His Majesty's Government were convinced that the measures taken by the Colombian Government to control the use of wireless telegraphy in Colombia would, if effectively and adequately carried out, be sufficient to prevent the abuse of this means of communication in the interest of our enemies. The Government at Bogota had, moreover, caused a preliminary inspection by a neutral wireless telegraph operator of the station of Cartagena, in order to ensure the efficient local execution of their instructions; and they had further stated that a competent neutral would be invited to inspect this station and report upon the adequacy of the measures taken, so that no doubt might remain that their instructions had been effectively carried out by the local authorities.—*Times.*

Secret Wireless.—A wireless station has been discovered in Lisbon, with branches in the neighbourhood. Five wireless operators connected with the establishment were arrested.

Telegraph Censorship.—In connection with the censorship of telegrams to places abroad, the Postmaster-General announces that arrangements have been made for the reimbursement of any unexpended balance of the charges remaining in the hands of the Post Office and of the cable companies which have been paid for telegrams stopped by the censors while in the course of transmission. The concession is subject to the following conditions:—

1. Reimbursement will not be made in respect of any telegram on which the unexpended balance is less than 4s.
2. Every application for reimbursement must be accompanied by a written statement from the addressee that the relative telegram has not been delivered.
3. No information can be given as to the method in which the amount reimbursed is arrived at, and no inquiry on this point can be entertained.
4. The arrangement will not apply to telegrams sent prior to June 15th, 1915.

Telephone Service Economies.—In compliance with a Treasury ruling, and in order to carry out a policy of economy, the G.P.O. is spending as little as possible on telephone extensions. Provision has to be made for services required for naval and military purposes, including what is required for the Munitions Department, and a number of circuits must be provided for other than Government special services; for instance, the War Loan involved new offices and telephone installations. The aim of the Post Office had been to restrict new installations for the public generally to such as appear to be necessary and circuits that do not involve large expenditure and do not make great demands on the much-depleted engineering staff. No hard-and-fast rule has been made that new installations are not to be undertaken, but an application must have a very good case to support it.—*Times.*

Telephones in Warfare.—Mr. Charles R. Darling, in the course of an address on "Field Telephones" at the Society of Arts last week, said that in the fighting zone at the present time flag signalling, being too conspicuous, had been abolished, and all communications from the trenches to the base and between the different units in a battery were carried out with the aid of telephones. With regard to the training of telephonists, he said that naturally, with the large armies that were being gathered together, the number of field telephonists who could be obtained was not as many as might be desired. He suggested therefore that science teachers should combine together and offer their services for the training of field telephonists.—*Morning Post.*

Wireless Control.—The United States Government is said to be negotiating for the purchase of a device for the wireless control of torpedoes, invented by Mr. John Hays Hammond, jun.

Wireless Libel.—An action was brought in the Chancery Division by Prof. Arthur Schuster, one of secretaries of the Royal Society, against the publishers and printer of *Pearson's Weekly*, in respect of an article suggesting that Prof. Schuster's private wireless apparatus was discovered and "seized." Defendants offered an ample apology, paid the costs, and gave 50 guineas to the Red Cross funds. The judge described the libel as a cruel one, Prof. Schuster's loyalty and good faith being beyond question.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Adelaide.—August 25th. Dry cells, earth clips, recording counters, and various other instruments and apparatus, for the P.M.G. See "Official Notices" July 9th.

September 1st. Condensers, testing sets, rheostats, Morse sounders, and Wheatstone transmitters for the P.M.G. See "Official Notices" July 23rd.

Perth.—August 25th. P.M.G. One ton of crushed salammoniac, and 1½ tons of steel galvanised wire. See "Official Notices" July 23rd.

August 25th. Common-battery telephones, for the P.M.G. See "Official Notices" July 30th.

September 29th. Telephone switchboard parts, for the P.M.G. See "Official Notices" July 30th.

Sydney.—September 13th. Council. A.C. and D.C. electric motors. Specification (10s. 6d.) from E.L. Department, Town Hall.*

September 6th. Metropolitan Board of Water Supply and Sewerage. Centrifugal pumps and electric motors at Richmond pumping station.* Acting Secretary, 341, Pitt Street, Sydney.

Melbourne.—August 24th. Telephone instruments, for the P.M.G.*

August 31st. Switchboard parts, for the P.M.G.*

Blackpool.—August 13th. T.C. Wiring and fitting for electric lighting of the new Military Convalescent Camp, Squire's Gate, Blackpool. Particulars, &c. (one guinea, returnable), from the Borough Electrical Engineer.

Bristol.—August 23rd. Corporation. One 6,000-kw. three-phase steam turbo-alternator with condensing plant. See "Official Notices" July 23rd.

Earby.—August 16th. Dynamo, wiring, &c., for electric light at the sewage disposal works, for the U.D.C. Mr. J. E. Aldersley, Engineer and Surveyor (returnable deposit of £1 1s.).

Glasgow.—August 12th. Corporation. Electric lighting installation at the Govanhill and district public baths and washhouses. Specifications from the Office of Public Works, 64, Cochrane Street.

London.—H.M. Office of Works.—August 13th. Twelve months' supply of incandescent electric lamps. See "Official Notices" to-day.

Middleton.—August 10th. Corporation. Coal for the electricity works. Particulars from Mr. S. Pauls, Electrical Engineer.

Pontardawe.—August 12th. Electric wiring and fittings for the new Police Court, for Glamorgan C.C. Mr. T. M. Franklen, Clerk, Cathays Park, Cardiff.

Salford.—August 9th. Supply of coal for the Electricity Department. Particulars from the Borough Electrical Engineer, electricity works, Frederick Road.

South Africa.—Johannesburg.—August 25th. 8,600 drawn-wire spiral filament traction lamps, spare parts for tramcars, for the Municipal Council.*

September 25th. For the T.C. Two turbo-alternator sets, condensing plant, switchgear, &c. Specification, &c., on deposit of £2 2s., from Mr. J. H. Dobson, General Manager.*

Wigan.—August 13th. Fifty tons of street tramway rails, B.S.S. No. 3; 150 cranked tie-bars; and 20 pairs of fishplates, B.S.S. No. 3. Particulars from Mr. A. T. Gooseman, Borough Engineer, King Street West.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The Sydney Municipal Council has accepted the following tenders:—

Supply of low-tension D.C. feeder panels.—Australian General Electric Co., £248.

Switchgear for A.C. sub-stations:

Extensions to existing Westinghouse switchgear.—Standard Waygood Hercules, Ltd., £1,062.

Extensions to existing Ferranti switchgear.—Noyes Bros., £1,036.

Extensions to existing B.T.H. switchgear.—Australian General Electric Co., £1,144.

18 5,000-volt feeder panels, £2,520; 30 5,000-volt transformer panels, £3,438.—Messrs N. Guthridge, Ltd.

22 415-volt transformer panels, £1,020; 28 415-volt distributor panels, £1,274; eight 415-volt summation panels, £575.—British General Electric Co.

Ferranti meters, 5, 10 and 25-amp.—Noyes Bros.

—*Australian Mining Standard.*

Brentford.—The tender of Messrs. Harrison & Gubbins has been accepted by the Guardians, at £48, to wire the Dundee, Grosvenor and Percy Houses.

Bundoran (Co. Donegal).—The Urban Council has accepted the tender of Messrs. Myles & Co., at £78, for lighting the town by electricity.

Chester.—The Refuse Disposal Committee has recommended the purchase by the Council of three Edison electric wagons (two-ton capacity) from Messrs. Drake & Gorham, Manchester.

Erith.—Subject to the L.G.B. sanctioning a loan, the U.D.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for a water-tube boiler and accessories for the electricity works, at £5,054.

Holmfirth.—The Electricity Committee has accepted the tender of Messrs. Swire & Co., Manchester, for a cooling tower and cast-iron tank.

Kingston-on-Thames.—The Lighting Committee has accepted the tender of Messrs. W. Cory & Son for 1,600 tons of Insdale rough small coal, at 22s. a ton.

Manchester.—The Electricity Committee has accepted the following tenders for the supply of stores required during the ensuing 12 months :—

Asbestos goods.—L. Andrew & Co.
Paper-insulated service cables.—B.I. & Helsby Cables, Ltd.
Dynamo brushes.—Wm. Patterson.
Carbon brushes.—Le Carbone, and Morgan Crucible Co., Ltd.
Earthenware bridges.—Doulton & Co., Ltd.
Earthenware pipes.—Isherwood Bros., Ltd.
Lampholders, tumbler switches, &c.—British Thomson-Houston Co., Ltd.
Single-pole damper fuses.—Samuel Gratrix, jun., & Bro, Ltd.
Firebricks and fireclay.—Glenboig Union Fireclay Co., Ltd.
Arc lamp resistances, copper strip, fuses, switches, &c.—Gaskell & Grocott.
Arc lamp resistances, copper strip, &c.—Bullers, Ltd.
H.T. corrugated racks.—Doulton & Co., Ltd.
Cable protectors.—Doulton & Co., Ltd.
Balata belting.—Charles Macintosh & Co., Ltd.
Armature tape, &c.—L. Andrew & Co.
Bitumen and other tape.—W. T. Henley's Telegraph Works Co., Ltd.
Steam and gas fittings.—James Russell & Sons and John Russell & Co., Ltd.
General wiring.—Liverpool Electric Cable Co., Ltd.
Fuse wire.—B.I. & Helsby Cables, Ltd.
Workshop flexible, &c.—Chas. Macintosh & Co., Ltd.
Flexible.—L. Andrew & Co.
Tubing and accessories.—Brotherton Tubes & Conduits, Ltd.
Tubing.—Eureka Conduits & Fittings Co.
Recorder paper.—Eckstein, Heap & Co., Ltd.
Hellesen dry cells.—A. H. Hunt.
Soldering paste.—W. P. Burnley & Co., Ltd.
Varnish.—Pinchin, Johnson & Co., Ltd.
Evertite packing.—R. L. Ross & Co., Ltd.
Crucible.—Morgan Crucible Co., Ltd.
Anti-sulphuric enamels.—Griffiths Bros. & Co.
Nickel chrome wire and strip.—Wiggins & Co.
Tinned-steel and armature wire.—W. N. Brunton & Son.
D.C.C., silk-covered and Eureka wire.—London Electric Wire Co. and Smiths, Ltd.
Enamelled wire.—Connolly Bros., Ltd.
Box compound.—Callender's Cable & Construction Co.
Adhesive tape.—Connolly Bros, Ltd.
Metal polish.—Matchless Metal Polish Co., Ltd.
Pipe compound.—W. H. Mitchell & Co., Manchester.
Boiler tubes, land type.—Babcock & Wilcox, Ltd., London.
Boiler tubes, marine type.—British Mannesmann Tube Co.
Compo. and plastic magnesia.—Newalls Insulation Co., Ltd.
Adamant.—S. & C. Bishop.
Thermometers.—T. Armstrong & Bro.
Packing.—Bell's United Asbestos Northern Agency.
Lion jointing and packing.—James Walker & Co., Ltd.

The Sanitary Committee has reaffirmed the resolution accepting the tender of Messrs. Siemens Bros. Dynamo Works, Ltd., for lamps. The tender was mentioned at the last meeting of the City Council, when the Town Clerk undertook to secure definite information from Somerset House as to the composition of the firm named. The tender of Messrs. L. E. Wilson & Co. for providing and fixing telephones at Monsall Hospital has been accepted.

The Electricity Committee has accepted the tender of Messrs. Johnson & Phillips, Ltd., for cable.

Menston.—The Wharedale Union Joint Hospital Committee has accepted the tender of the Leeds Private Telephone Co., at £135, for installing telephonic intercommunication between the different wards of the hospital.

Rotherham.—The Corporation Electricity and Tramways Committee has accepted the following tenders for coal for the Electricity Department :—

Earl Fitzwilliam's Collieries.—6,000 tons of slack, at 14s. per ton.
Sheepbridge Coal & Iron Co., Ltd.—4,000 tons of Glapwell smudge, at 11s. 8d. per ton.

Salford.—The Electricity Committee has accepted the following tenders :—

Bertram Thomas.—Switchgear for rotary converter, £392.
F. Mitchell & Sons.—Alterations and additions to buildings and the construction of foundations at the Frederick Road station, £1,070.
Alton & Co., Ltd.—Piping, &c., for additional 5,000-KW. turbo-alternator, £279.

Material and stores for the period ending March 31st, 1916 :—

W. T. Glover & Co., Ltd.—Unarmoured cable.
Dussek Bitumen Co.—Joint-box compound.
G. Hattersley & Sons, Ltd.—White tape.
Henley's Telegraph Works Co., Ltd.—Rubber strip.
General Electric Co., Ltd.—Copper fuse wire.
Doulton & Co., Ltd.—Stoneware conduits, £100.
B.I. & Helsby Cables, Ltd.—Maximum-demand indicators, £95.
Le Carbone.—Motor carbon brushes.
David Walton & Co.—Meter boards and blocks.
Vacuum Oil Co., Ltd.—Cylinder oil.

Southampton.—The T.C. has received nine tenders for the supply of coal to the electricity works for periods of three, six, or twelve months, and has decided to purchase from Messrs. Cory Bros. & Co., Ltd., 6,000 tons, at 21s. 3d., and 2,000 tons from Messrs. A. Usher & Co., at 21s. 9d. per ton.

Watford.—The U.D.C. has accepted the tender of Messrs. Bowaters for 1,560 tons of Baddesley bean coal for the electricity works, at £1 1s. 6d. per ton.

Willesden.—The tender of Messrs. Venables has been accepted by the D.C. for the provision of telephonic communication between various departments of the municipal offices and the temporary offices recently erected.

Woodford.—The U.D.C. has accepted the tender of the Walter's Electrical Manufacturing Co., for the installation of fire alarms, at a payment of £88 on completion of the work and £88 annually for four years.

Woolwich.—The following tenders have been accepted on the recommendation of the Electricity Committee :—

Babcock & Wilcox, Ltd.—Coal and ash-handling plant, coal chutes and rack valves, £1,175.
Willans & Robinson, Ltd.—Set of re-action and impulse blading for turbines, £94 10s.

FORTHCOMING EVENTS.

North of England Institute of Mining and Mechanical Engineers.—Saturday, August 7th. At 2 p.m. At Newcastle-on-Tyne. Annual meeting.

NOTES.

Educational Notes.—MUNICIPAL SCHOOL OF TECHNOLOGY, MANCHESTER.—The prospectus of University courses provided by the School of Technology for the session 1915-16, has just been issued; it contains an account of the splendidly equipped laboratories—in the department of Electrical Engineering there are four 100-KW. generating sets and a 50-KW. turbo-generator, as well as over 100 motors, aggregating 1,250 H.P. A novel feature of the prospectus is a series of summaries of approved courses, which students proceeding to the degree of B.Sc.Tech. or the Certificate in Technology are recommended to follow.

UNIVERSITY OF BRISTOL.—The session in the Faculty of Engineering will commence on September 14th; in Science, &c., on October 1st. Particulars are given in our advertisement pages to-day.

The Manufacture of Insulators in Australia.—In the *Melbourne Age* for June 8th a lengthy and interesting article appears relating to efforts that are being made at Box Hill, within 10 miles of Melbourne, in connection with the manufacture of insulators. Some time ago in the district named a remarkable deposit of clay was discovered, having many of the properties essential to the manufacture of art pottery and a special suitability for the non-conductive properties desired in insulators used for telegraphic and electrical purposes. Vast quantities of insulators are used annually throughout Australia. The Postal Department alone has an annual consumption of about 800,000, while electrical supply undertakings are also large users. The Commonwealth Art Pottery and Insulator Co. acquired this valuable bed of clay, and has since worked it, mostly in the production of insulators. The company had to start from the beginning and train men to fashion the goods for which there was the best market. Gradually it succeeded. Insulators were made for the Postal Department and for various private consumers; the works were considerably extended, new plant laid down, and additional kilns erected, until in time the establishment became an important factory, employing from 70 to 80 hands. Prior to the war insulators were imported from Germany and Austria; a few came from Japan. The Box Hill works might compete with European manufacturers, but had no chance against labour that considered itself handsomely remunerated at 7s. per week. Recently the Postal Department called for tenders for insulators involving a considerable supply. Imagine the consternation among the shareholders and employés of the Commonwealth Art Pottery Co. when the rumour got about that the Postmaster-General intended to accept a Japanese tender. Happily, however, the Commonwealth Art Pottery Co. obtained an order for 200,000 insulators. The works are now in full swing.

The writer proceeds to give a brief account of the manufacturing and sorting operations and processes. "There are six filter presses producing about 10 tons of plastic clay per day; the two pug mills treat a similar quantity; three stamping machines have each a capacity of 3,000 insulators per day; the 13 lathes have an average capacity of 500 per day; the 4 kilns have an average capacity of 9,000, and the average stock in process of manufacture is 45,000. Insulators only are produced, the clay being especially suitable for the manufacture of high-tension ware. It is practically the only deposit of clay in the State which has so far turned out any considerable quantity of insulators suitable for electrical installations. In addition to being used by the Commonwealth Government, the company's insulators find customers in the Melbourne Electric Supply Co., the Councils of Northcote, Brunswick and Port Melbourne, the North Melbourne and Essendon Electric Tramway Co., and numerous local and inter-State firms. The bulk of the output, however, has been absorbed by the Postal department, private orders being necessarily of an intermittent character. Although numerous attempts have been made in a small way to supply high-tension insulators, only the Commonwealth Art Pottery Co. has succeeded on any extensive scale. "Being a combination of primary and secondary production, the industry should become one of the settled activities of the Commonwealth. The manufacturing cost is made up of about 92 per cent. labour and 8 per cent. material. The industry is subjected to a Wages Board, and the rate of pay is considerably higher than the rate of wages in foreign countries. Germany and Austria, hitherto the chief suppliers, pay wages of one-third to one-half those fixed by the Wages Board, and, despite the sneers of the free trade organ about undue preference to local industry, it is to be hoped no Government contract will ever be allowed to run in that direction. With the perfecting of the plant and appliances, and the increased skill of operatives, a steady reduction in the cost of manufacture may be anticipated."

Fire.—The *Daily News* states that the electric power station at the Ebbw Vale works, near Newport, was completely destroyed by fire on Sunday. It was well equipped with the latest machinery, and it is estimated the damage will amount to thousands of pounds. "Thousands of men are rendered idle. The fire is believed to have been caused by the fusing of live wires. Practically all the local industries have been brought to a standstill, and as electricity was supplied to the town the streets of Ebbw Vale are in darkness."

Fatality.—On Wednesday, last week, an accident took place at the works of the Shipley Fan Co., electrical and ventilating engineers, Valley Works, a young man—James Rogers, mechanic—whilst standing on a ladder attending to some belting having his right arm caught and being whirled round the shafting. The arm was taken right off, and the injured man was removed to Saltaire Hospital.

An inquiry was held at Gateshead-on-Tyne, on the 2nd inst., into the death of Andrew Turnbull Crook, a chargeman, at Redheugh Colliery. A stoneman at the colliery, named Walter Harbottle, said that early on the morning of July 30th Crook said to him that as it was getting near food time and the place was drained he would stop the electric pump. Crook went away, but did not return, and as he (Harbottle) wanted a shot fired he sent a man named Mucklow to seek Crook. Mucklow returned and said he could not rouse Crook, who was lying on his side and appeared to be dead. Witness went to the pump and found Crook lying near the switch. The current was switched off. There was a burnt mark on Crook's right wrist, and his nose had been bleeding. Artificial respiration was tried but without success. Edward Watson, an electrician at the colliery, said there were three switches connected with the pump. Crook would pass in front of the pump to the switch on the main cable. He would shut that off, then he would shut off the starting switch, and, finally, the brush switch. After the accident witness went to the pump and found all the switches correctly turned off. He found deceased lying on the ground alongside the switch to the main cable. Witness examined the main cable and found about 6 in. of the cable with the insulating material torn off. The cable was insulated with rubber, then tape, and again with cotton braiding. The portion of cable to which he referred was quite bare. He found a piece of the cable tape lying between the switches. He examined the cable and switches on July 26th, and then they were all right. The jury returned a verdict that deceased had been "electrocuted," but there was no evidence to show how he had come into contact with the current.

Trading with the Enemy.—The Public Trustee, as custodian for England and Wales of enemy property, has issued a special notice to the Press drawing the attention of bankers, traders and others to important provisions of the new Act as follows:—

1. Dividends and interest payable in respect of all classes of securities held for enemies are now payable to the custodian. Under the provisions of the new Act interest on securities issued by, or on behalf of, British, Colonial or Foreign Governments, or Corporations or municipal or other authorities, and moneys representing the payment off of the capital of any securities are payable to the custodian. The duty of making such payments to the custodian, and of furnishing him with the necessary particulars, rests with the person, firm or company through whom the payments in the United Kingdom are made.

Accountable parties should apply to the Public Trustee for Receivable Order "A," upon which the return should be made. No money should accompany the receivable order, but a warrant directing payment will be issued in due course.

N.B.—Where coupons or drawn bonds to bearer are held for the accounts of enemy persons the holder should apply to the office of the Parliamentary Counsel, Whitehall, S.W., for a licence authorising the presentation for payment of such instruments, and should apply to the Public Trustee for copies of Receivable Order "A," which should be completed and handed to the paying authority, upon whom the duty will then fall to account to the custodian.

2. The obligation to register property with the Public Trustee under Sec. 3 (1) of the earlier Act is now extended to (*a*) bank balances and deposits; (*b*) debts to the amount of £50 and upwards.

All persons, firms or companies with whom enemies have bank balances or deposits or who owe £50 or more to enemies (apart from those dividends, &c., payable to the custodian) should apply to the Public Trustee for Registration Order "F."

N.B.—The Act provides that the liability to disclose property of any nature held for enemies shall apply to companies as well as to persons and firms.

Companies who have not already disclosed property under Sec. 3 (1) of the old Act should therefore apply to the Public Trustee for Registration Order "B."

The term "enemy" means any person or body of persons of whatever nationality resident or carrying on business in the enemy country, but does not include persons of enemy nationality who are neither resident nor carrying on business in the enemy country.

Attention is called to the penalties fixed by the Trading with the Enemy Amendment Act, 1914, for non-compliance with the requirements thereof, and to the fact that such penalties will also apply for non-compliance with the requirements of the present Act.

L.C.C. Tramway Wages.—The ballot of the L.C.C. tramway employés shows a big majority in favour of accepting the Conciliation Board award as against Board of Trade arbitration. The award offered the men a war bonus of 3s. per week, or 6d. a day to men earning 40s. per week or under. The claims of the men for a permanent increase of wages of 1s. per day, overtime at the rate of time and a half, an extra allowance of 2s. 6d. per day to motormen on trailer cars, and a reduction in the hours of labour to eight daily were refused by the Conciliation Board.

Indian Trade.—A Reuter dispatch from Simla states that in view of the success which has attended the sample exhibition of goods heretofore imported from Germany and Austria-Hungary recently held in Calcutta and other centres, the Government has decided to establish a permanent commercial museum in Calcutta in order to bring manufacturers and traders together and develop the natural resources of the country.

Volunteer Notes.—The Birmingham Electrical Engineers (Volunteers) have been in camp at Luddington, a village on the banks of the Avon, from Friday to Wednesday last. They have had about 400 names on their books, but as over 50 men have joined the Regular Forces, and a large number of the remainder are on Corporation and Government work, it was not expected that more than 100 men would be able to go into camp. The force was under Sub-Commandant D. Shanks.

ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS.—Headquarters—Marconi House, Strand, London, W.C.

Drill Centre.—By kind permission of Lieut.-Colonel A. E. Le Rossignol, head-quarters of London Electrical Engineers, 46, Regency Street, London, S.W.

Company Orders.—By Lieut.-Colonel C. B. Clay, V.D., Commandant, for week ending August 14th, 1915.

Monday, Wednesday and Friday.—Drills, 6.30 and 7.30 p.m.

All applications for enrolment should be sent to the Commandant, Marconi House, Strand, from whom all particulars can be obtained.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON REGIMENT (VOLUNTEERS).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, August 5th, 1915:—

Captain of the week, Capt. Eastwood; Orderly Officer, Mr. R. P. Groom Johnson.

Week-end Parades.—Saturday, August 7th.—The Battalion will parade at 2.30 p.m., at Baker Street Station, and entrain for Wembley. Officers will bring with them notebooks and sketching material.

Sunday, 7 a.m., reveille; 10 a.m., Church Parade; 10.20 a.m., Parade under Company Commander; 2.15 p.m., Battalion Parade.

Resignations.—The following members, having obtained temporary commissions in His Majesty's Forces, are placed on the honorary list of the corps:—Mr. Last Smith, London Welsh; Mr. O. Onion, Royal Engineers; Mr. B. Strachan, 3/24th County of London Regiment (Queen's); Mr. Frank K. Chater, The Welsh Regiment; Mr. Wilfred H. Carey, Army Service Corps.

The following extracts from C.A.V.T.C. letter, dated July 20th, 1915, are published for information:—"'Previous military training, if any' (Paragraph 4 of Corps Register Form XII), shall be taken to include previous military service in a Volunteer Training Corps. It will be necessary, therefore, for all recruits to answer this question accordingly. No man shall be accepted as a member of any Unit of the Volunteer Training Corps, who less than three months previously has been a member of any other Unit, except with the consent of his original Commanding Officer.

"*Drill.*—The completion of 40 drills does not do away with the obligation for Volunteers to continue to attend drills. A member of a Volunteer Corps who does not attend a minimum of four drills per month shall be liable to be struck off the roll of the Corps, unless absent on leave given by the Commanding Officer of his Unit."

Establishment.—The Establishment for a Company is as follows:—One Acting Company Sergt-Major; one Company Q.-M. Sergeant; four Platoon Sergeants; eight Corporals; eight Lance-Corporals. This Establishment is on no account to be exceeded. Any Company above these numbers must absorb men already appointed before further appointments can be made.

Musketry.—Saturday, August 7th, Acton Range, 2.30 p.m., "C" Company, as previously arranged. Members of "C" Company wishing to shoot should send in their names to their Company Commander without delay.

On Saturday, August 7th, there will be a 500 yards' target at Bisley, for members who have not previously shot, and who send in their names to the Musketry Officer not later than Friday morning, 6th inst. Members will report themselves to Sergt. Cotter, at No. 9 Barrier, Waterloo Station, 12.45 p.m.

Acton Range.—There will be shooting as usual on Tuesday and Thursday, at 2.30 p.m.

A. G. JOINER, *Captain and Adjutant.*

Board of Trade Inquiries.—The Board of Trade Commercial Intelligence Branch has issued its list, No. 32, for the week ended July 31st, giving particulars of further inquiries received for names of makers of specified articles. Under "Electrical Apparatus and Accessories," inquiries were received for electric cables, and felt tape for insulated wire covering.

X-Ray Gift to France.—The most up-to-date travelling X-ray motor ambulance that has ever been constructed is about to be sent from London to the Front. It cost over £1,000, subscribed by the public to the fund organised by the London Committee of the Scottish Women's Hospitals (N.U.W.S.S.), and will be attached to the field hospital at Royaumont.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—An error occurred in the paragraph which appeared in our last issue respecting Mr. L. Marshall Jockel. Mr. Jockel has resigned his appointment as engineer-in-charge of the York Corporation electricity and tramways department to take up the position of assistant engineer to the Government of Malta electric lighting department at Valetta. During his period of service with the York Corporation he also held the post of Lecturer on Electrical Engineering at the N.E. Railway Institute Evening Classes, which classes are arranged for students from the city as well as from the railway company.

Mr. Archibald J. Howard, borough electrical engineer of Taunton, was married on July 28th at the Albemarle Baptist Chapel, Taunton, to Miss Florence U. Taylor. On the previous day the staff and employés of the electricity department presented Mr. Howard with a clock, Mr. R. J. Yendall, works' foreman, acting as spokesman on their behalf.

Mr. F. A. Nicholls, of the Islington electricity department, has been appointed chief assistant engineer in the electricity department of the Leek Urban District Council.

Mr. Tom Hudson, eldest son of Mr. C. W. Hudson, of Bradford, has been granted a commission as Sub-Lieut. in the Royal Navy. Lieut. Hudson has been employed at the Lancaster electricity works, and also at Devonport on Government work.

Mr. H. A. Ratcliffe, head of the testing department of the Manchester electricity works, has been co-opted a member of the Manchester Air Pollution Advisory Board, which was formed some time ago by the Manchester City Council.

Mr. R. H. Fox has been appointed chief electrical engineer at Musselburgh (Scotland), at a salary of £215 per year.

The marriage took place at All Saints' Church, Frindsbury, Rochester, on July 22nd, of Mr. J. A. Smith, of the Kent Electric Power Co., and Miss Winifred Edith Whyte, eldest daughter of Mr. Andrew Whyte, of Frindsbury.

By 9 votes to 4 the Redditch U.D.C. has adopted a report of the Electricity Supply Committee recommending that the application of Mr. R. Mayne for an increase of £100 per annum in his salary be refused.

On July 17th Mr. W. Coles, charge engineer at the Luton Corporation electricity works, was married to Miss R. Bowles, of Cambridge. Mr. Coles's colleagues at the works presented him with a dinner service.

Tramway Officials.—The Manchester Tramways Committee has acceded, on certain conditions, to an application of Mr. Mattinson, chief civil engineer, for permission to be allowed to apply for a commission in the Royal Engineers.

Mr. A. J. Bousfield, assistant manager of the Isle of Thanet Tramway Co., has secured a similar appointment with the Chatham and District Light Railway Co.

General.—A distinguished conduct medal has been awarded to Private A. Hotz, of the 1st East Surrey Regiment, for conspicuous gallantry on "Hill 60," when he placed himself in front of a communication trench occupied by the enemy, and, on the enemy advancing, attacked them with hand grenades and dispersed them. Before the war Mr. Hotz was employed in the construction department of the British Thomson-Houston Co., Ltd., and the members of the B.T.H. staff are naturally very much pleased with the winning of this reward for gallantry by one of their number.

On the eve of departure for Australia, Mr. W. A. Holmans, a member of the staff of the Edison & Swan United Electric Light Co., Ltd., Ponder's End, Middlesex, for over 16 years, was presented by the staff with a diamond ring, a cabin trunk and a pocket-book. Mr. Holmans is to be stationed in the Ediswan showroom, at Melbourne.

The vacancy caused by the death of Mr. James Walmsley, who had charge of the electric plant at the Blackpool Tower, Grand and Palace, has been filled by the appointment, out of 240 applicants, of Mr. Wm. Quayle, assistant superintendent engineer to the British-American Tobacco Co., Liverpool.

We have received a copy of the first number of the *Staff War Bulletin*, issued by the County of London Electric Supply Co., Ltd. It has been published for private circulation, and while it is of great interest as showing what members of the staff are now doing in connection with the war, it will also be of permanent value as a record of the part played by the employés of the County and Associated Companies in the great national struggle. A full Roll of Honour is followed with notes regarding, and photographs of, those of the number who have been killed in action; also a list of wounded; and extracts from letters from men at the Front. Among a number of general notes, we read that Mr. J. B. Braithwaite, the chairman of the company, has two sons on active service in the Dardanelles; Captain A. E. Sanderson, son of one of the directors (Mr. A. H Sanderson), is also at the Front. One son of Mr. C. P. Sparks, the engineer-in-chief, has been awarded the military cross, and has been twice mentioned in dispatches, and two other sons of the new I.E.E. President, are also on service as lieutenants. 168 members of the County and Associated staffs are serving as special constables.

On July 28th, at Holy Trinity Church, Kingsway, W.C., a marriage took place between Mr. Frederick E. Chilton, London manager for Messrs. Royce, Ltd., of Manchester, and Miss Winifred Elsie Eleanor Gordon, daughter of the Rev. S. C. Gordon, M.A., B.D., of Bromley, Kent.

Mr. A. D. Bergtheil, electrical engineer, a natural-born British subject, has, by a deed poll, renounced the surname of Bergtheil and assumed the name of Berkeley in place thereof.

Roll of Honour.—Private Henry Herbert Davenport, who was with the British Thomson-Houston Co, Ltd., of Rugby, has been killed in action in France. He was shot through the head by a sniper.

Private Ll. L. Jones, of the Plymouth Battalion Royal Naval Division, who has been killed in action in the Dardanelles, was on the staff at the tramway depôt at Johnstown. He joined the Royal Marines last October.

Private Alexander Hanley, of Manchester, who is officially reported "missing" since June 28th, was serving with the 1/4 Royal Scots at the Dardanelles, and prior to the war was an apprentice with the British Westinghouse Electric and Manufacturing Co., Ltd., at Trafford Park.

Obituary.—Mr. Robert Hammond.—We deeply regret to learn, as we go to press, that Mr. Robert Hammond passed away on Thursday morning, at the age of 65 years. Mr. Hammond had been unwell for several weeks past, and had been unable to attend at his office. We shall refer to the deceased gentleman's career next week.

The *Sydney Daily Telegraph* records the death, which occurred at Rylstone early in June, at the age of seventy-eight years, of Mr. Audley Coote, who is described as "the father of Australia's Pacific cable service." His last work in this connection was the laying of the cable between Queensland and New Caledonia. "For successfully carrying out this undertaking Mr. Coote was to have received the French Legion of Honour, but he died before the formalities preliminary to the acceptance of this honour by a non-Frenchman had been completed." He was a lifelong friend of, and co-worker with, the late Sir Henniker Heaton.

We regret to note from the *Times* "Deaths" column that Mr. John C. Gill, Assoc.M.Inst.C.E., chief engineer to the city of Peterborough, has passed away at the age of 63 years. In his capacity as city engineer he was also responsible for the electricity supply system.

The death occurred on July 27th of Mr. Jas. Smith, head of the firm of Jas. Smith & Sons, Ltd., electricians, &c., Carmichael Road, South Norwood. Deceased, who was in his 87th year, served on the Croydon Town Council for 17 years.

The death occurred suddenly on July 26th, from heart disease following neuritis, of Mr. Fredk. John Gale, who was for many years associated with Brooking & Co., electrical engineers, of Queen Street, Exeter.

Will.—According to the *Times*, the late Major Flood Page left £5,671.

NEW COMPANIES REGISTERED.

Ramsden Green, Ltd. (141,122).—This company was registered on July 27th, with a capital of £2,000 in £1 shares, to take over from F. J. Green the business of an electrical and mechanical engineer carried on by him at 10, Wagner Street, Old Kent Road, S.E., as the Crathorne and Green Manufacturing Co. The subscribers (with one share each) are: F. J. Green, 10, Wagner Street, Old Kent Road, S.E., engineer; B. E. Green, 154, Beulah Hill, Norwood, S.E., private secretary. Private company. The number of directors is not to be less than two or more than five; the first are F. J. Green (permanent) and B. E. Green. Remuneration of F. J. Green, £300 per annum. Registered office: 10, Wagner Street, Old Kent Road, S.E.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Accumulator Co., Ltd. (125,172).—Capital, £13,900 in 4,000 "A" and 8,000 "B" shares of £1 each, and 38,000 defd. of 1s. each. Return dated December 31st, 1914 (filed March 24th, 1915). 4,000 "A" and 38,000 defd. shares taken up; 18s. per share called up on 4,000 "A"; £3,200 paid, leaving £400 in arrears; £1,900 considered as paid on 38,000 defd. shares. Mortgages and charges: Nil.

Greenwood and Batley, Ltd. (27,098).—Capital, £400,000 in 14,000 pref. and 26,000 ord. shares of £10 each. Return dated July 13th, 1915. 11,066 pref. and 18,052 ord. shares taken up (of which 13 ord. shares have been forfeited); £10 per share called up on 6,934 pref. and 12,134 ord., £3 per share on 1,466 pref., and £5 per share on 1,252 ord.; £201,312 paid, leaving £26 in arrears; £73,320 considered as paid on 7,332 shares (2,666 pref. and 4,666 ord.). Mortgages and charges: £100,000.

Electric Supply Co. of Western Australia, Ltd. (56,551).—Capital, £100,000 in £1 shares. Return dated June 23rd, 1915. 75,007 shares taken up; £46,607 paid; £28,400 considered as paid. Mortgages and charges: Nil.

Guildford Electricity Supply Co., Ltd. (36,725).—Capital, £55,000 in 25,000 pref. shares of £1 each, and 6,000 ord. shares of £5 each. Return dated April 14th, 1915. 18,856 pref. and 3,059 ord. shares taken up; £34,153 paid, including £2 on two ord. shares forfeited. Mortgages and charges: £25,000 1st and £15,000 2nd mortgage debs.

Hastings and District Electric Tramways Co., Ltd. (82,521).—Capital, £372,942 10s. in 130,000 pref. shares of £1 each and 485,885 ord. shares of 10s. each. (Originally £500,000 in 50,000 pref. and 50,000 ord. shares of £5 each. Reduced, 1911.) Return dated March 23rd, 1915. 80,000 pref. and 268,235 ord. shares taken up; £80,000 paid on the pref.; £134,117 10s. considered as paid on the ord. Mortgages and charges: £250,000.

CITY NOTES.

County of Dorset Electric Supply Co., Ltd.

At the meeting held on July 14th, at Moorgate Court, E.C., the directors submitted their report for 1914. They showed that the capital expended and invested in the associated companies amounted to £30,044. The revenue receipts, exclusive of the Lyme Regis dividend, amounted to £1,062, against £46 for 1913. The gross profit (including the dividend for the Lyme Regis Co.) amounted to £340. Against this were placed interest on temporary loans £500, leaving a deficit on the year's operations of £160, against a deficit of £654 in 1913.

The subsidiary companies, viz., the Lyme Regis E.L. & P. Co., Ltd., the Blandford Forum and District E.S. Co., Ltd., and the Swanage E.S. Co., Ltd., have each shown satisfactory progress. The Lyme Regis Co. shows a substantial profit on the year's working, and a dividend of 10 per cent. has been declared. The Blandford Co.'s supply was commenced only three weeks prior to December 31st, 1913, and the Swanage Co. has only been operating for about eleven months, so that these companies are only in their first year of working. The number of consumers in Dorchester on December 31st was 89, in Blandford 39, in Lyme Regis 126, and in Swanage 70. The company's progress from its inception to the present moment has been uniformly steady and satisfactory.

Electric Supply Corporation, Ltd.

The report of the directors for the year ended December 31st, 1914, shows that the gross earnings during the year amounted to £35,646, an increase of £956 upon the corresponding figures of the previous year. The sum taken into net revenue account amounted to £17,883, as against £15,655 for 1913. After paying interest upon debenture stock and the actual cost of the year's repairs and renewals, there remained with the balance brought forward from the previous year a surplus of £9,844, which the directors proposed to deal with as follows:—To place the sum of £273 to the renewals account, making this fund £10,000; to place £3,000 to a reserve fund; to distribute dividend to the shareholders at the rate of 2¼ per cent. per annum for the year 1914, less income tax, and to carry forward the balance of £1,847. The following table shows the progress made by the company:—

Year.	Equiv. 32-watt lamps connected.	Units sold.	Gross earnings.	Profit, including investments.
1912	186,207	3,730,780	32,387	13,449
1913	201,266	3,975,091	34,690	15,655
1914	214,715	4,258,981	35,646	17,883

The Hendon Electric Supply Co., Ltd., distributed a dividend of 13 per cent. for 1914, and the Dumbarton Burgh and County Tramways Co., Ltd., a dividend of 1½ per cent. upon its ordinary shares. The total amount received has been brought into these accounts.

	Lamps connected. (Equivalent in 32-watt lamps.) 1913.	Increase.
Chelmsford	37,242	2,166 (Decrease.)
Jedburgh	3,880	211
Melrose	5,138	201
Dalkeith	8,255	758
Dollar	3,214	102
Totnes	6,175	551
Exmouth	17,995	1,632
St. Andrews	25,481	1,371
Hitchin	11,217	1,212
Dumbarton	65,360	7,804
Falmouth	17,309	1,773
Net increase during 1914, 13,449.		
Hendon	97,636	17,803
Dawlish	2,850	855
North Berwick	681	907

These figures take no account of the supply to the Dumbarton Burgh and County Tramways, which used 626,709 units in 1914.

Mr. J. G. B. Stone (chairman) presided at Salisbury House, on July 29th, over the thirteenth annual meeting of the company. The Chairman, in proposing the adoption of the report, expressed regret that the accounts were not in the shareholders' hands at an earlier date, owing to delay caused by the depletion of the head-office staff, many of whom had joined His Majesty's Forces. They would note the satisfactory growth in the number of lamp connections; in the case of Chelmsford they had to record a lower figure than last year, due to the withdrawal of a large customer whom they had supplied at an exceptionally low rate for a number of years, so the reduction in lamp connections was not accompanied by a corresponding loss in profits. The Hendon Co., in which they were largely interested, was progressing most favourably, as evidenced by the handsome dividend they received on their shareholding. The Dumbarton tramway paid the same small dividend, but they hoped would ultimately yield a better return. In connection with Dumbarton, last year he told them they had arranged for a bulk supply for the town, but as the war caused considerable delay in the delivery of the necessary plant, it was only during the current year that the supply had become of beneficial use to them. As regarded the sale of current, he did not think they had been adversely affected by the war, as they had had an increased demand for power supply, more particularly in Dumbarton, which was an active centre for shipbuilding. In other places, dependent on visitors for their prosperity, the ordinary business had been replaced to a large extent by increased trade brought by the billeting of troops. As to the other side of the account, namely, the production of electricity, the actual cost during the year under review had not been very materially affected, though they would have to face higher prices for labour and coal in future. A very large number of their staff were serving with the Forces, and they had at present only 54 per cent. of the men who were in their employment at the outbreak of the war. They recommended bringing the renewals account up to a sum of £10,000, and proposed to continue paying for repairs and renewals out of the yearly revenue, unless they had to meet some abnormal expenditure. There was a considerable increase in their bill for repairs, due to renewal of their batteries. Most of their works had now been in operation for about ten years, and a battery did well if it lasted for that period. It was particularly to meet battery repairs that this fund was built up, and it was gratifying to feel that they could carry out such work without trenching upon it. They now proposed to inaugurate a general reserve fund, setting aside £3,000 for that purpose. Apart from general depreciation charges, they had to bear in mind that item on the balance sheet representing the cost of issuing shares and debentures, and the shareholders would no doubt agree that it would be wise to make some provision of this nature. With regard to the dividend, the board did not think it politic to pay more than 2¼ per cent. The small additional payment under the present conditions was encouraging and marked the general improvement in face of the difficult conditions which had prevailed.

The report was adopted without discussion.

Bombay Electric Supply & Tramways Co., Ltd.

The tenth ordinary general meeting was held on Thursday last week at Electrical Federation Offices, Kingsway, under the presidency of Sir C. Ollivant, K.C.I.E.

In proposing the adoption of the report (see p. 52), the Chairman said it was gratifying to note that the net revenue had continued to expand, notwithstanding many adverse factors. The gross receipts amounted to £302,569, an increase of £26,100, and the net receipts to £157,582, an increase of £12,010, or of 8.25 per cent., as compared with the previous year. The adverse effect of the war upon the traffic had been mainly due to the heavy falling off in both the export and import trade of the port of Bombay, and to the measure of impoverishment resulting from the trade shrinkage. For the first seven months of the year, prior to the outbreak of the war, they carried 24,192,216 passengers, as compared with 23,092,082 during the corresponding months of 1913. But for the second five months they only carried 16,257,418 passengers, as compared with 17,599,940 the year before. Owing to the increase in receipts during the first half of the year, the aggregate gross earnings for the twelve months showed a falling-off of only £788. The decrease in net earnings of £4,961 was, consequently, mainly attributable to the fact that the traffic expenses for 1914 exceeded those of 1913 by £4,173. This was due to the increased expenditure necessitated by the increased running during the earlier months of the year, and to the fact that the decrease in the later months under this heading was offset by the rise in the cost of materials and heavier expenditure on the maintenance of rolling stock and track. They would be glad to note that there had been a recovery in the scale of the traffic receipts since the commencement of the current year, and this, so far, continued to progress. The progress of the electric supply branch of the undertaking had been very satisfactory, the net earnings showing the handsome advance of £17,700 as compared with those of the preceding year. They were fortunate in securing temporary supply for power purposes to two of the Bombay mills during the last six months of 1914; those mills were under contract to purchase electric energy from the Tata Hydro-Electric Co., so soon as that company was able to supply them, and it was in a position to do this early in February, when these two customers passed to the Hydro Co. As that company had now commenced supply at Bombay, it was perhaps desirable that he should remind them that under the terms of its licence it was restricted to supplying factories and railways whose annual consumption was not less than 500,000 units. The fields of operation of the two companies were, therefore, to that extent demarcated. In view of the loss of the temporary mill load, they could not look for the same increase in revenue from the supply branch this year as that recorded last year. But he was glad to be able to inform them that for the five months of the current year, for which returns had reached them, there had been a considerable increase in the number of units sold as compared with last year. All the extensions of the mains laid

last year were yielding good results. With regard to the balance sheet, during the year the capital expenditure aggregated £46,461. Of this amount, £36,195 was expenditure in the supply branch, and £10,266 in the traction branch. The provision for depreciation was increased this year to £27,000, as compared with £23,500 last year. They had now at credit of that fund £113,400. The sinking fund for capital redemption had been increased from £41,686 to £57,198. They had found it advisable to postpone for the present some extensions of the tramway lines which they had in contemplation. The very heavy rise in the cost of materials and the adverse influences checking the normal growth of the traffic had dictated this postponement. But, on the other hand, they were steadily pursuing the policy of extending their supply mains into any districts of the city not yet served by their distributors, where it was demonstrated as the result of careful canvassing that the returns in sight justified the expenditure. The progressive realisation by all classes of the Bombay public of the conveniences and economy of electric lighting, and the hygienic benefits of electric fans, had resulted in a growth in the demand for both which rendered possible many extensions which could not have been justified a year or two ago.

Mr. F. C. Rimington seconded the motion, which was carried unanimously.

Yorkshire Electric Power Co.

The report of the directors for the half-year ending June 30th, 1915, states that there has been an increase in the revenue from the sale of electrical energy, but owing to additional costs occasioned by the war, the net profit after payment of mortgage and other interest shows a small decrease on that for the corresponding half-year of 1914. Both wages and materials have become more costly during the war, and the conditions of the coal market have been especially difficult. The net profits for the three half-yearly periods ending June 30th are:—

1915.	1914.	1913.
£9,873 8s. 9d.	£10,414 5s. 0d.	£6,971 18s. 9d.

Under the powers conferred upon them by the Yorkshire Electric Power Act, 1914, the directors have declared a dividend for the half-year on the amount paid up on the six per cent. cumulative preference shares, which will absorb £5,051 3s. 3d., and they are of the opinion that under the circumstances the consideration of a dividend on the ordinary shares should be deferred until the end of the year. The advantages which have repeatedly been claimed for a public supply of electricity have been emphasised by the present conditions. Old consumers have increased their demands upon the company, and many important new consumers are being supplied. Power users whose premises are connected to the company's mains find that with a minimum of expenditure and without delay they are able to meet the unprecedented requirements for war and other purposes. During the half-year applications for £10,995 of the six per cent. cumulative preference shares have been received, and the balance unissued has now been reduced to £2,845. Owing to over one-fifth of the company's employés having enlisted and to the growth of the business, more work has fallen upon a depleted staff. The directors have pleasure in drawing attention to the cheerful spirit with which these extra responsibilities have been undertaken.

Russian Electrical Companies.

The electrical concerns in Russia possessing a good organisation, both for buying raw materials and selling their products, as well as having abundant working capital, were never more prosperous than they have been of late. This can be seen from the following figures from the published reports for the working year 1914:—

	Profits in roubles.		
	1912.	1913.	1914.
General Electricity Co. ...	1,300,000	1,750,000	2,070,000
United Cables Co.	970,000	1,400,000	3,340,000
Siemens & Halske	640,000	500,000	810,000
Duflon Constanovitch & Co.	240,000	250,000	350,000
Siemens-Schuckert	—	1,300,000	1,150,000

Amongst these concerns the United Cables Co. is particularly distinguished by its net profit, namely, 55.6 per cent. on its nominal capital, or more than double that of 1913.

How, asks a Petrograd journal, has such an unprecedented increase taken place in such an abnormal year, when other branches of industry were in more or less difficulty? This question is answered by the report of the company itself, which shows that at the beginning of the war, the company had in stock reserves of metals and other necessary goods for production, which had been bought in the first half of the year at low prices, whilst the finished products were sold in the second half of the year, when prices steadily rose.

The satisfactory position of the company is explained, also, in part by its participation with three other concerns in the consumers' syndicate, called the "Abnehmer-Syndikat." This is a union of consumers of copper which, on its part, is bound by agreements with the Russian syndicate of copper smelters, called the "Myed." Under such conditions it can be understood how the company in the last three years made a net profit of 6,000,000 roubles, or the equal of its nominal capital. Further, the increase in the profits of this company, as well as of others closely associated with it—the General Electricity Co., and Siemens & Halske—is explained by the large orders given for war service. A considerable portion of the profits of all these companies has been put to the amortisation of the cost of buildings, etc., notwithstanding the fact that most of them, as shown below, have paid higher dividends than in 1913.

	Dividends per cent.		
	1912.	1913.	1914.
General Electricity Co.	9	9.4	10
United Cables Co.	8	10	15
Siemens & Halske	6	5	6
Siemens-Schuckert	—	6	5
Duflon Constantinovitch & Co.	12	12½	10

In the first four companies named, down to the period of the war German capital was chiefly interested; but the last-named is French. The house of Siemens-Schuckert is an exception: its dividend was less compared with that of 1913. The decline in the profit of this large concern which, two years ago, with the co-operation of important German electro-technical groups, was formed from the Russian Schuckert Co., is explained by the fact that it was largely dependent on its foreign contractors, both financially and industrially. Some idea of this dependence may be found in the report of the said company. It says that the result for 1914 is less satisfactory than that of the preceding year, because of the impossibility of executing certain portions of the contracts from the company's works, through the stoppage of the importation of special machines then being made abroad, and the impossibility of constructing machines in the factory of the company in time, in view of the complete stoppage of delivery of raw materials and half products.

The report of the General Electricity Co. also specifies the lack of raw material as well as of fuel at the factory, and the impossibility of obtaining equipment, previously obtained from abroad, which had an unfavourable influence on the operations of the company in 1914.

To-day, amongst electro-technical concerns, there is observed an effort to get rid of foreign control. Thus the board of Duflon Constantinovitch & Co., in its report points out the necessity of fresh extensions of the factory equipment due to the desire to experiment in some new branches of productive activity in the sphere of electro-mechanics to be installed in the workshops of the company, so as to take an active part in freeing Russia from that foreign control.

At present accounts of three other large electric companies have also been published for 1914, and these show that the demand for electric current in 1914 was good. In connection therewith the net profits increased as compared with 1913, as can be seen from the tables (in roubles) which follow:—

	1912.	1913.	1914.
Electric Lighting Co., 1886	5,350,000	6,040,000	6,840,000
Petrograd Electric Constructions Co.	1,400,000	1,520,000	1,740,000
Electric Power Co.	590,000	1,050,000	1,400,000

The dividends per cent. paid by these companies were as follow:—

	1912.	1913.	1914.
Electric Lighting Co., 1886	11	11	11
Petrograd Electric Constructions Co. ...	9	10.2	10.2
Electric Power Co.	—	9	9

British Columbia Electric Railway Co., Ltd.

Owing to the large decrease in the earnings of the company since the turn of the year, the directors are unable to recommend the payment of any further dividend on the preferred or deferred ordinary stocks in respect of the year to June 30th. In the last days of 1914, owing to the stagnation of business, brought about by the war, an extraordinary form of competition suddenly arose; a large number of motor cars, most of them privately owned, started plying for hire in opposition to the company's cars, at ordinary tram fares. In an endeavour to meet this competition the company has recently, as an experiment, reduced some of its fares. Sufficient time has not yet elapsed to enable a conclusive opinion to be formed as to the ultimate result of this step. The approximate net earnings of the company and its subsidiaries for the six months to December 31st last amounted to £190,585, a decrease of £61,252, or 24 per cent., as compared with the earnings for the corresponding period of the previous year. For the six months to June 30th, 1915 (the period of motor-car competition), the approximate net earnings show a still greater decline of £152,379, or 65½ per cent., as compared with the earnings of the corresponding period of the previous year, making an approximate decrease in the net earnings for the year of £213,631, equal to 44 per cent. The approximate net earnings for the twelve months to June 30th amount to £270,588. An extraordinary general meeting will be held on August 19th, for the purpose of passing resolutions confirming two agreements which have been entered into between the company and two of its subsidiary companies, for the operation by the company of branch lines owned by the subsidiary companies, and for matters incidental thereto.—*Financial News.*

Kensington and Knightsbridge Electric Lighting Co., Ltd.—Interim dividend of 3 per cent. on the ordinary shares, for the half-year ended June 30th, 1915.

Vickers, Ltd.—The following interim dividends for the half-year to June 30th will be paid:—2½ per cent. (less income-tax) on the preferred 5 per cent. stock and 5 per cent. preference shares, and 1s. per share (free of income-tax) on the ordinary shares.

Westminster Electric Supply Corporation, Ltd.—Interim dividend at the rate of 6 per cent. per annum, less income-tax, for the half-year to June 30th, payable on September 1st.

Metropolitan Electric Supply Co., Ltd.—Dividend on the ordinary shares for the half-year to June 30th at the rate of 2 per cent. per annum.

London and Suburban Traction Co., Ltd.—The directors announce that no interim dividend will be paid on the ordinary shares at this time.

City of London Electric Lighting Co., Ltd.—The directors announce an interim dividend at the rate of 6 per cent. per annum, less income-tax, on the ordinary shares for the half-year.

City of Buenos Ayres Tramways Co. (1904), Ltd.—The directors have declared a dividend of 1s. 3d. per share (being at the rate of 5 per cent. per annum), less income-tax, for the three months ended June 30th.

Blackpool and Fleetwood Tramroad Co.—The directors have decided to pay the usual dividend, at the rate of 4 per cent. for the half-year ended at June.

Official Notices re Companies.—The following companies will be struck off the register at the expiration of three months, unless cause is shown to the contrary:—

Auto-Electric Vacuum Drying Syndicate.
Automatic Centrifugal Pump.
Boudjah Electric Lighting Co.
Chapman Motor Starter Syndicate.
East Kent Electric Supply Co.
Filaments.
Radiographic Processes.
Ridge Speed Indicator Syndicate.
Silico Bitumen Co.
Simplex Life Guard and Step Co.
Small Power Dynamo and Motor Co.
Society for the Protection of the Motor Trade.
Treibel Smoke Combustion Co.

Para Electric Railways and Lighting Co., Ltd.—No interim dividend will be paid on the ordinary shares.

STOCKS AND SHARES.

Tuesday Evening.

Principal interest in the Stock Exchange continues to centre in the 4½ per cent. War Loan. Upon the establishment of an active market in the scrip, there was a sharp fall in the price, the partly-paid dropping at one time to 2½ discount. This, however, was halved at the beginning of the present week, and with the recovery in the stock, other investment markets sympathised. The newcomer monopolises most of the business that is going on. There is probably fifteen to twenty times as much doing in the War Loan as in any other single security outside the Consol market. This state of affairs is likely to continue for a week or two, after which business will quietly slide into the normal, although, of course, there are still many issues, in investment markets especially, which will have to come down in price, in order to conform to the lowered standard of levels—or, to put it in another way, the higher rate of yield—set up by the War Loan.

This is a condition which will apply to various stocks and shares in our own price lists. Those people who ask why quotations are not lowered straight away, to meet the altered circumstances, may be reminded that since the issue of the War Loan, at the end of June, business in most markets has been of meagre character, and that, so far, only in certain cases have the markets been sufficiently tested to enable the quotation of approximately accurate prices. It might be difficult to sell various of the stocks set out in our lists at the given prices, although we would venture to say that in the majority of those enumerated the market has sufficiently accustomed itself to the War Loan atmosphere to permit of accurate prices being obtained.

The Electrical Supply list is featureless and devoid of alteration. Dividend declarations so far have emphasised the cautious note sounded here at various times as to the effect of the war upon the profits of the electricity-producing companies. The Westminster has reduced its interim dividend from 10 per cent. to 6 per cent., and this reduction of 4 per cent. is the principal cut announced up to the present. The St. James' and Pall Mall, it will be remembered, lowered its interim dividend to 7 per cent., which is 3 per cent. less than that of the corresponding period last year. The Metropolitan 2 per cent. goes against 4 per cent., and the Charing Cross declares 4 per cent. against a point higher. The City of London and County of London, with 6 per cent. and 5 per cent. respectively, make no difference in their distributions As may be supposed, the market is somewhat dull, but, as we have just said, there are no quotable changes.

The Adelaide Electric Supply Co. has convened a meeting of its 5 per cent. debenture stockholders for next Monday week (August 16th), to consider and, if approved, to pass certain extraordinary resolutions, the adjective being literally as well as formally correct. The debenture proprietors are asked to consent to a variation of the trust deed, on the ground that the deed, as at present drawn, contains a clerical error in the matter of the amount of money to be set aside towards redemption of the stock by 1936. The new clause to be proposed provides for an accumulative sinking fund, the effect of which would be to redeem the stock—certainly not in the twenty-one years from now, as at present provided, but in a considerably longer period. To talk about a clerical error in a trust deed when that error touches so vital a spot as redemption of the debenture stock seems to us most surprising. This debenture has been recommended here from time to time as a first-class security, well covered; and one of its attractions lay in its being redeemable at 105 in 1936. To move the date on, even by ten or twenty years, on the excuse that the trust deed contained a clerical error, is surely an attempt to infringe debenture rights which should be stoutly resisted; and those who have followed the suggestion that they should invest money in the security may be further advised to oppose the present proposals in every way possible.

The Brazilian Traction Co. has declared a dividend of ¼ per cent. on its common shares in respect of the past quarter; and if it repeats the distribution three months hence, the dividend for the year will be brought up to 4 per cent. What will happen after this, however, is a theme for much speculation. Will the company declare quarterly dividends of 1 per cent.? or is the present ¼ per cent. to be continued? This is the point disturbing the market; and the price of the shares has fallen to 45½—comparing, it may be noticed, with 66 on the eve of the outbreak of war.

The Rio exchange has been moving within the past few days against holders of Brazilian securities, although of this factor too much need not be made, in view of the speculation which is going on in the Exchange just now. The Argentine group is quiet, and Mexican descriptions are not affected by the news, for what it may be worth, that the Carranzists have already started on a scheme of pacification, and that regular communication between Mexico and Vera Cruz is about to be restored. The British Columbia Electric Railway has passed the dividends on its preferred and deferred stocks. Prices, naturally, are dullish. Nominally, the two issues stand at 45 and 35 respectively. The preference is called 65 to 70.

Telegraphs, on the whole, are weak and depressed. Little or no support has been forthcoming to counteract the fall of the past month. Prices continue to crumble, and this partially from the considerations outlined in our opening paragraphs. The American group has derived no benefit from the wild speculation in all kinds of United States industrials that is taking place in New York. Some of the Canadian stocks and shares are better because of it, and American Marconis furnished one of the surprises of the week with a jump from 14s. to 20s. 6d. in a single day. Of this rise about a florin was subsequently lost. Canadian Marconis moved up in sympathy to 5s. 9d., and the parent shares benefited from the spurt in their progeny. Marconi ordinary rose temporarily to 2, and, being now ex-dividend, the net rise at 38s. 9d. amounts to 4s. 6d. per share; while the preference have hardened to 1 13/16, and even Spanish Marconis, from being scarcely saleable at 2s. 6d., soared to 6s. New York Telephones rose to 97, but subsequently lost the advance of a point which this represented. The Eastern and Western groups are both dull, the deceased accounts not having yet been fully absorbed.

Home Railway stocks are steady, a fall of a point in Metropolitans being counteracted by a similar improvement in Districts, while Underground Electric issues maintain their recently-acquired firmness.

The Miscellaneous group shows little change. Manufacturing shares are steady as a whole, but Telegraph Constructions fell a point to 31, and preferences are generally disposed to ease off. In the rubber market there is not much going on, with a consequent quietude in prices. The armament division is a little erratic. It may be mentioned, incidentally, that at one of the munitions-making companies which has a factory not a hundred miles from the City, a gang of Stock Exchange men find more strenuous employment than has been their lot for many years past in the House.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Aug. 3, 1915.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	8	—	£6 5 0
do. 7 per cent. Pref.	7	7½	—	4 10 4
Charing Cross Ordinary	5	4	—	6 5 0
do. do. do. 4½ Pref.	4½	4	—	5 12 6
do. do. City Pref.	4½	3⅝	—	5 16 2
do. 4 Deb.	4	80	—	5 0 0
Chelsea	5	4½	—	5 11 1
do. 4½ Deb.	4½	88	—	4 17 10
City of London	9	13	—	6 18 6
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	100	—	5 0 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10½	—	6 13 4
do. do. 6 per cent. Pref.	6	10½	—	5 14 3
do. do. 1st Deb.	4½	90	—	5 0 0
do. do. 2nd Deb.	4½	85	—	5 6 0
Kensington Ordinary	9	6½	—	6 18 6
London Electric	4	1⅝	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	6 6 4
do. do. 4 Deb.	4	80	—	5 0 0
Metropolitan	8½	8	—	5 16 8
do. 4½ per cent. Pref.	4½	3½	—	6 0 0
do. 4½ Deb.	4½	90	—	5 0 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	7	—	7 0 0
do. do. do. 7 per cent. Pref.	7	6½	—	5 12 0
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	3	—	6 13 4
South Metropolitan Pref.	7	1⅛	—	6 4 5
Westminster Ordinary	9	7	—	6 8 7
do. 4½ Pref.	4½	4⅛	—	4 17 4
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	97	—1	6 3 6
do. Def.	1½	21	— ½	7 2 10
Chile Telephone	8	6⅞	—	5 18 5
Cuba Sub. Ord.	5	8¼	—	6 1 3
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	11	— ⅛	*7 5 6
do. 4 Deb.	4	78 xd	—	5 2 7
Eastern Tel. Ord.	7	190	—1	*6 18 4
do. 3½ Pref.	3½	70	—	5 0 0
do. 4 Deb.	4	80	—	5 0 0
Globe Tel. and T. Ord.	6	9⅛	— ½	*7 4 4
do. Pref.	6	10	—	6 0 0
Gt. Northern Tel.	22	33	—	6 13 4
Indo-European	65/-	60	—2	6 10 0
Marconi	10	1⅛ xd	+4/6	5 3 1
New York Tel. 4½	4½	96	—	4 13 9
Oriental Telephone Ord.	10	1⅞	—	5 6 8
do. Pref.	6	1⅛	—	5 6 8
Tel. Egypt Deb.	4½	80	— 8	5 0 0
United R. Plate Tel.	8	6⅝	—	*7 19 10
do. Pref.	5	4	—	5 2 7
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	11⅛	— ½	*6 19 0
do. 4 Deb.	4	81	—	4 16 5
Home Rails.				
Central London, Ord. Assented	4	74	+1	5 8 1
Metropolitan	1½	28½	— ½	5 6 5
do. District	Nil	14	+1	Nil
Underground Electric Ordinary	Nil	1⅜	+ ⅛	Nil
do. do. "A"	Nil	6/-	—	Nil
do. do. Income	6	75	—	*9 8 0
Foreign Trams, &c.				
Anglo-Arg. Trams, First Pref.	5½	4	—	6 17 6
do. 2nd Pref.	5½	3½	—	7 17 2
do. 4 Deb.	4	75	—	5 6 8
do. 4½ Deb.	4½	75	—	6 0 0
do. 5 Deb.	5	75	—	6 13 4
Brazil Tractions	4	45½	— 2½	8 17 10
Bombay Electric Pref.	6	10½	—	5 16 10
do. 4½ Deb.	4½	90	—	5 0 0
Mexico Trams	Nil	33	—	Nil
do. 5 per cent. Bonds	—	50	—	Nil
do. 6 per cent. Bonds	—	80	—	Nil
Mexican Light Common	Nil	20	—	Nil
do. Pref.	Nil	30	—	Nil
do. 1st Bonds	—	45	—	—
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	99	—	5 1 0
Manufacturing Companies.				
Babcock & Wilcox	14	9½	—	6 4 5
British Aluminium Ord.	5	1⅜	—	4 11 1
do. Pref.	6	18/8	—	6 9 9
British Insulated Ord.	15	11	—	6 13 4
do. Pref.	6	6	—	5 0 0
British Westinghouse Pref.	7½	33/6	—	8 19 2
do. 4 Deb.	4	70	—	5 14 4
do. 6 p. lien	6	100	—	6 0 0
Callenders	15	11	—	6 16 4
do. 5 Pref.	5	4⅞	— ⅛	5 5 9
do. 4½ Deb.	4½	95	—	4 14 9
Castner-Kellner	15	8½	—	4 12 6
Edison & Swan, £3 pd.	Nil	11/6	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60	—	6 13 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	11/6	—	10 8 8
do. do. Pref.	7	1	—	7 0 0
Gen. Elec. Pref.	6	9⅜	—	6 3 1
Henley	20	14	—	*8 3 3
do. 4½ Pref.	4½	4⅛	—	4 14 9
do. 4½ Deb.	4½	95	—	4 14 9
India-Rubber	5	8⅜	—	5 14 3
Telegraph Con.	20	31	—1	7 15 0

* Allowance made for dividends being paid free of income-tax.

Charing Cross, West End and City Electricity Supply Co., Ltd.—Interim dividend on the ordinary shares of the West End undertakings for the half-year ended June 30th, 1915, at the rate of 4 per cent. per annum. Warrants will be posted on August 14th.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, August 4th.

CHEMICALS, &c.	Latest Price.	Fortnight's (inc. or Dec.
a Acid, Hydrochloric per cwt.	4/6	..
a " Nitric "	19/-	..
a " Oxalic per lb.	..	..
a " Sulphuric per cwt.	..	..
a Ammoniac Sal "	£49	..
a Ammonia, Muriate (large crystal) per ton	£40	..
a Bleaching powder "	£9	..
a Bisulphide of Carbon "	£21	..
a Borax "	£22	..
a Copper Sulphate "	£28	..
a Lead, Nitrate "	£35	..
a " White Sugar "	..	..
a " Peroxide "	..	..
a Methylated Spirit per gal.	..	..
a Potassium, Bichromate, in casks per lb.	7½d.	..
a Potash, Caustic (88/90 %) per ton	..	..
a " Chlorate per lb.	1/6	..
a " Perchlorate "	1/6	..
a Potassium, Cyanide (98/100 %) "	Nom.	..
(for mining purposes only)		
a Shellac per cwt	65/-	..
a Sulphate of Magnesia per ton	..	..
a Sulphur, Sublimed Flowers "	£11 10	..
a " Recovered "	£8	..
a " Lump "	£8 10	..
a Soda, Caustic (white 70/73 %) "	£10 2 6	..
a " Chlorate per lb.	1/1	..
a " Crystals per ton	45/-	..
a Sodium Bichromate, casks per lb.	4d.	..
METALS, &c.		
b Aluminium Ingots, in ton lots per ton	..	..
b " Wire, in ton lots (1 to 14 S.W.G.) "	..	..
b " Sheet, in ton lots "	..	..
e Babbitt's metal ingots "	£50 to £221	..
c Brass (rolled metal 2" to 12" basis) per lb.	1/1⅞ to 1/2½	..
c " Tubes (solid drawn) "	1/2½ to 1/2¾	..
c " Wire, basis "	1/3 to 1/2½	..
c Copper Tubes (solid drawn) "	1/1⅞ to 1/2¼	..
g " Bars (best selected) per ton	£102	£4 dec.
g " Sheet "	£102	£4 dec.
g " Rod "	£102	£4 dec.
d " (Electrolytic) Bars "	£88	£7 dec.
d " " Sheets "	£106	£7 dec.
d " " Rods "	£94	£7 dec.
d " " H.C. Wire per lb.	11¼d.	¾d. dec.
f Ebonite Rod "	8/-	..
f " Sheet "	2/6	..
a German Silver Wire "	1,10	..
h Gutta-percha, fine "	6/10	..
h India-rubber, Para fine "	2/5	1¼d. dec.
f Iron Pig (Cleveland warrants) per ton	66/-	7d. dec.
f " Wire, galv. No. 8, P.O. qual. "	£26	£3 inc.
g Lead, English Pig "	£24 15	£1 dec.
g Mercury per bot.	£18 5	..
c Mica (in original cases) small per lb.	4d. to 2/6	..
c " " " medium "	3/- to 5/-	..
c " " " large "	6/6 to 10/6 & up	..
c Nickel, sheet, wire, &c. "	Nom.	..
g Phosphor Bronze, plain castings "	1/1 to 1/3½	..
g " " rolled bars & rods "	1/2 to 1/8½	..
g " " rolled strip & sheet "	1/3½ to 1/6½	..
c Platinum per oz.	185/-	..
d Silicium Bronze Wire per lb.	1/8	..
r Steel, Magnet, in bars per ton	£33	..
g Tin, Block (English) "	£158	£9 dec.
g " Wire, Nos. 1 to 16 per lb.	2/8	..
g White Anti-friction Metals per ton	£52 to £194	..
k Zinc, Sh's (Vieille Montagne bnd.) "	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
j Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

J. F. & G. Harris, Ltd.—The directors report that the total number of shares allotted is 12,554 3 per cent. cumulative preference shares of £1 each, and 21,404 ordinary shares of 2s. 6d. each. Seven of the ordinary shares have been allotted for cash and 17s. 6d. has been received in respect of such shares. 12,554 3 per cent. cumulative preference shares and 21,397 ordinary shares have been allotted as fully-paid shares in accordance with the agreement between J. F. & G. Harris and this company, dated June 22nd, 1915. The statutory meeting is to be held to-morrow.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be quoted in the Official List :—

Calcutta Electric Supply Corporation, Ltd.—2,178 ordinary shares of £5 each, fully paid, within Nos. 250,001 to 260,000; and 2,014 5 per cent. cumulative preference shares of £5 each, fully paid, within Nos. 200,001 to 210,000.

Winnipeg Electric Railway Co.—Further issue of £400,000 4½ per cent. perpetual consolidated debenture stock.

THE ELECTRICAL TRADE POSITION IN CHINA.

By GEO. R. ARCHDEACON, A.M.I.E.E

At present China is in a state of muddle, out of which British, German or American influence will, in the near future, develop Law, Order and Commerce. The object of this article is to present to the British manufacturer a few hints that may assist him in capturing the extensive trade that remains to be developed in this great country of China.

First and foremost, one must try to realise the appalling indifference of the Chinese to new ideas, and the intense suspicion of all forms of change in thought or action. Yet if the deeply-rooted Conservatism of the country can be overcome, and the people's interest excited, there is to hand crude material out of which it is possible to make rapid progress in the most modern forms of civilization and culture.

In a recent paper on this subject, Prof. Middleton-Smith, of the Hong-Kong University, estimated that "for all practical purposes, China is entirely devoid of roads, and more than 99 per cent. of the inhabitants are living under conditions which are the same as those which existed in China 2,000 years ago. Ninety per cent. of the inhabitants have never heard of a steam engine or a heat engine of any kind."

It is into this primitive country that the engineer must bring his wares, and by all the powerful aids of legerdemain and the usual tricks known to modern commerce he must so contrive to engage the attention of the natives as to lull their suspicions and allay all their fears of devils, fiends, demons and dragons.

It is here where the British manufacturer's "slap-dash" methods and "take it or leave it" system are of no avail. If Spain is the land of "to-morrow," China is the land of "next week." Nothing less than a devil or a demon can make John Chinaman hasten out of his usual bland contemplation of life and all its complexities. The British manufacturer may send out smart, well-groomed voluble representatives by the battalion, but few of them will return laden with orders. Talk carries no conviction to the Chinese mind. Past-master in the art of "bluff" himself, he is "too old a bird" to be caught in such a simple trap.

It is first necessary to send out a man who has had previous experience in handling Chinese labour, one who is somewhat familiar with the Chinese and their peculiar temperament. He must possess an abundance of tact and patience, with a sympathetic leaning towards the Chinaman, his objects and ideals; he must be most polite and obliging; above all, he must be scrupulously honest and just in all his transactions, but firm in whatever attitude he finally adopts.

The Chinaman always asks three times the amount he hopes to ultimately secure; consequently he expects you to play the same game. After you have made your demands, both parties amicably settle down to an amusing and friendly argument, politely depreciating each other's criticisms, but slowly and surely reducing the price until you have finally arrived at your pre-determined figure. All this takes time, but unless you are prepared to engage in these friendly discussions and display no haste to take your departure, precious little custom can the British manufacturer hope to obtain from this land of dirt, dollars and doubt.

It frequently happens at home that, to assure the satisfactory working of a special piece of machinery, your representative must make a suitable impression upon the *man who works that machine* rather than the manager or director who simply buys it. The author could some tales unfold of the unsatisfactory working of machinery that persistently refused to become efficient until the operator's prejudice had been finally overcome. This item most especially applies to China, the great land of "squeeze." The Chinaman loves "squeeze." The author is of the opinion that a Chinaman would be perfectly happy if you were to reduce his wages, say, 2s. per week, but allowed him to make 1s. 9d. per week in squeeze.

Every Chinese makes "squeeze"—and that is why a representative who is strictly honest may be considered simple; yet he ultimately gains their respect and confidence, and when he has once accomplished that feat the road to success is wide open.

The Chinaman only accepts the evidence of his own eyesight, therefore I would suggest to British manufacturers that whenever there is a technical college or university opened in China, they should give it their strongest support. Let the samples of their work be in constant application in the various laboratories of those institutions, so that the rising generation of Chinese may be familiar with their products and convinced of the soundness of their adoption, to the exclusion of all other methods. Let all British manufacturers adopt the principle that "all things of interest to China are of interest to us."

Just to cite one small instance which, nevertheless, shows to what an extent the lack of interest and lack of information have hitherto permeated the British manufacturers in things concerning China.

The author (at Hong-Kong) has personally received from engineering firms at home, letters stamped with 2½d. stamps instead of 1d. stamps. He has also had the same experience brought to his notice by other engineers domiciled out here.*

The British Electrical and Allied Manufacturers' Association and the China Association are both steps in the right direction. I would suggest that manufacturers should see that all their agents in China are constantly supplied with leaflets advertising their wares *written in Chinese*.

The two principal dialects are so dissimilar as to necessitate different translations; therefore the leaflets should be printed in Pekinese for North China, and Cantonese for South China.

The Singer Sewing Machine Co. have long realised this necessity, and not only do their leaflets abound, but wherever one goes a dainty Chinese lady may be observed on large advertisement boards sewing away on the inevitable Singer machine, whilst the accompanying letterpress matter is all in Chinese.

Throughout the whole of China there are practically only three towns wherein the modern industries have been developed upon anything approaching a large scale. These towns are Hong-Kong, Shanghai, and Hankow. Hong-Kong is a British colony, and as such possesses all the marked features of British rule, namely, law, order, sanitation, and a general feeling of peace, and security of life and property. Hong-Kong possesses two great shipyards, run upon similar lines to those at home, equipped with all the latest machinery and appliances for shipbuilding and general engineering work. There is also a large Government shipyard equally well equipped. These three engineering works employ between them about 600 Europeans and 10,000 Chinese. In this colony we have two electrical companies and one tramway company.

The Hong-Kong Electric Co. operates on the island in the city of Victoria. Its station is a mixed one consisting of about 2,000 KW. in Diesel engine sets, and about 700 KW. in steam plant. The Tramway Co. possesses a generating station consisting of steam plant of 800 KW.

Across the water is situated Kowloon, on the

* We are more familiar with the complaint that letters are insufficiently stamped.—Eds. E.R.

mainland about three-quarters of a mile from Victoria. In Kowloon one of the above-mentioned dockyards has its works.

The China Light and Power Co., Ltd., operates the electric lighting scheme in Kowloon. Extensive developments are at present in hand, as this company is changing from the 2-phase to the 3-phase system of supply, and is replacing a 500-KW. suction gas plant by a 1,500-KW. turbine station.

Knitting and weaving factories abound in this district, also rope works, cement works, a sugar refinery, and numerous small engineering works requiring a power supply of from 5 to 50 H.P.

Some 90 miles from here is the famous city of Canton, the population of which is well over a million. The Canton Electric Supply Co. has a Diesel station of some 1,600 KW. In this part of South China there are also small electricity stations at Fatshan and on the island of Macco.

Striking out towards the North, we have Swatow, Amoy, and various small towns already equipped with pumping stations, mills, mines, and electricity supply stations.

In North China there is the cosmopolitan city of Shanghai, which is a model of the development that can be brought about in China if British firms will spend more money, more time, and more energy in their attempt to open this great market that only awaits a well-directed policy for development.

Can the British manufacturer realise that in Shanghai, thousands of miles away from the beaten track of his operations, there is a generating station of some 20,000 KW., fully equipped with all that is best in modern electrical practice? This district is also full of cotton mills, engineering works, mines, shipbuilding works, rope works, breweries, cement works, etc.

The interior of China is beginning to waken up. Already there is in Yunanfu a 25,000-volt scheme with a transmission line of over 25 miles. Small isolated plants are gradually becoming dotted all over the country—at Nanking, Heungshan, Cheung Chow, Kongmoon, Hoihow, Peking, and Changsha. The best hotels are all equipped with electric light and electric lifts; and in many cases are generating their own power. How many British firms have their products installed in these various places?

German and American goods have held sway and secured most of the trade. Germany is, for the moment, removed from active operations. Are we going to step in and win, or are we going to stand aside and merely timidly angle with a few cheap catalogues as our only bait, instead of boldly sending out good men with an ample supply of literature, plenty of samples, and having a fairly free hand with regard to credits, contracts, and a system of free trials with small machines? For a matter of about £700 a good man might be sent out to China on a twelve months' tour.

If the prospect before the eyes of the British manufacturer does not warrant the sporting risk of £1,000 to get a footing in the Chinese markets, let him by all means stick to his home trade, with his carefully planned system of personal and banker's references, and his usual timid attitude of carefully dipping his big toe into the water to feel if it is too cold.

Whilst he stands miserably shivering on the bank he will doubtless derive some pleasure (!) in watching the antics of his foreign and American competitors who have boldly plunged in, and from their loud acclamations of joy seem to be in no doubt of the success of their venture.

STROBOSCOPIC FREQUENCY MEASUREMENTS.*

THE light emitted by an incandescent solid varies much more rapidly than its temperature, and makes it possible to measure the frequency of an alternating current by observing stroboscopically the frequency of the illumination peaks in a thin, gas-immersed filament incandesced by the current in question. Referring to fig. 1, if A represents the impressed E.M.F. wave, and if, for simplicity, the wire be taken to have zero temperature coefficient of resistance, the current wave will be undistorted and in phase with A, and the rate at which energy is dissipated will be represented by the sine-squared curve B.

In the case of a filament of infinitesimal thermal capacity (such as can be realised approximately by mounting a thin filament in a gas-filled bulb), the temperature of the wire at any moment is approximately represented by the curve B.

The (monochromatic) candle-power curve C is much more peaked than the energy wave, and it is found that a gas-cooled filament will give sharp stroboscopic effects even when operated on sinusoidal current. In the case of a thin filament operated in a vacuum, the considerably less peaked curve D of candle-power is secured. Gas immersion makes the heat capacity of a filament negligible, even though the latter is not excessively thin, and thus produces sharper stroboscopic effects than are obtainable from a vacuum lamp.

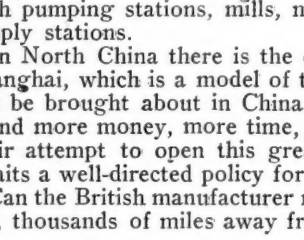


FIG. 1.—TIME VARIATION OF LIGHT FROM A RAPIDLY-COOLED FILAMENT.

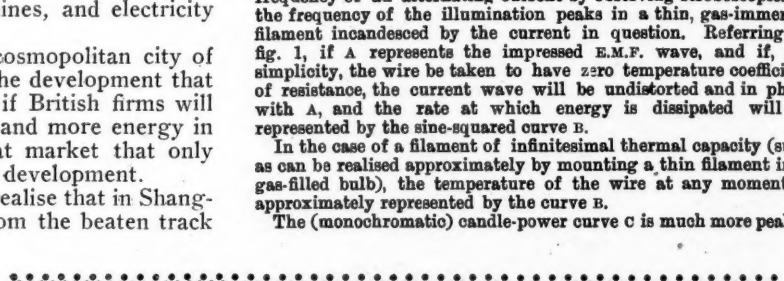


FIG. 2.—STROBOSCOPIC SCREEN.

Stroboscopic frequency measurement requires a dotted or otherwise marked disk and an intermittent illumination: either the speed of rotation of the screen or the frequency of the intermittent illumination must be proportional to the frequency to be measured, and the other factor, whichever it be, must be constant. The best procedure is to drive the stroboscopic disk at absolutely constant speed—say by directly coupling it to a 10-pole attracted-iron synchronous motor operated by a vibrator making 10 contacts per second. Motor and vibrator windings and contacts may be connected in series across the A.C. supply, the frequency of which is to be determined. The motor runs in synchronism with the vibrator. To avoid hunting and facilitate synchronising, the moment of inertia of the system may be divided into two parts, one being that of a small fly-wheel rigidly mounted on the armature shaft, the other that of the drum on which the stroboscopic screen is mounted. The latter drum is best driven by rubber bands from the motor shaft or fly-wheel. This arrangement ensures absolute steadiness of rotation of the stroboscopic disk, and when the moment of inertia of the system is properly divided and the flexible connection properly adjusted, the motor drops into synchronism (one revolution per second) at once on being twirled by the fingers.

Fig. 2 shows an improved form of stroboscopic screen containing two series of alternating dots (as first used by Seashore). The screen is mounted on the circumference of a drum, and the row of dots which apparently stand still, when illuminated by intermittent light in synchronism with the current examined, is readily identified since the rows on either side of it appear simply as streaks and give a marked "framing" effect. The screen illustrated has 39 rows of dots; the number of dots in a row varies

* *Elec. Review and Wn. Electrician.*

from 29 to 67, and the screen is thus suitable for indicating frequencies between $29/2 = 14{\cdot}5$ and $67 \times 2 = 134$ per second. A 30-cycle current gives 60 illuminations per second, hence the 60-dot row appears stationary; 60-cycle current produces 120 illumination peaks per second, hence the 60-dot row again appears stationary, but with the dots at half their actual distance apart. The rows are numbered on two fixed scales—one for each series; the overlapping of the dots at higher frequencies does not prevent the detection of exact synchronism. The frequency indications are independent of the wave-form of the alternating current employed, and a simple portable reed vibrator gives sufficiently constant frequency of current interruption in the motor circuit for all ordinary purposes.

ON AN UNBROKEN ALTERNATING CURRENT FOR CABLE TELEGRAPHY.

By Lieut.-Colonel GEORGE O. SQUIER, Ph.D.

(*Abstract of Paper read before* The Physical Society of London, *June 25th*, 1915.)

(*Concluded from page* 158.)

The ideal alphabet to employ in cable signalling would be one in which, other things being equal, each letter had the same limit of legibility; because if this is not so, the speed of signalling is lowered to meet the legibility of certain letters only. In present cable practice, what may be called the "resolving power," or the definition, is not equal throughout the letters of the alphabet.

Letters like "a" or "n," for instance, may be considered as perfect letters, and whether sent by one complete cycle of E.M.F. of a dynamo, or by two square-topped waves of equal area and opposite sign separated by a time interval, produce on the siphon record approximate sine-waves. On the other hand, in the case of letters like "s" or "h," where three or four square-topped waves of the same sign are sent into the cable consecutively, the received record at high speed fails to resolve these separate impulses, and the siphon record becomes a more or less continuous hump of large amplitude, which the expert operator learns to read without being able to detect the individual impulses; in fact, some practical operators seem to prefer these letters to what are known as "cross-letters," such as "a" and "n."

Careful experiments have been conducted through long cables, which prove, however, that the so-called "cross-letters" have a superior legibility, which obviously should be the case from theoretical considerations only.

We may consider the siphon record of an uninterrupted alternating current as possessing 100 per cent. definition, independent of the frequency, the voltage employed, or the particular cable used, and regard it as the standard of definition for all signals. Indeed, such a record is, in fact, a message composed of a series of the letter "a" joined together without spaces between.

In present practice it is found necessary to insert a receiving condenser in series with the recorder coil, or an inductive shunt around the coil, for the purpose of improving the definition of certain letters of the alphabet, such as "s" and "h," as well as to eliminate from the record the effects of earth currents of very low frequency induced in the cable.

One of the chief attractions in the use of an unbroken alternating current for operating the cable is the fact that for the first time we are enabled to measure the constants of the different elements of the bridge and cable circuits employed under actual signalling conditions. Since one particular frequency is used and the current is never broken, it is necessary and sufficient to use the ordinary commercial hot-wire ammeters and voltmeters which are now available over suitable ranges.

A tachometer is attached to the dynamo armature shaft, so that the frequency is indicated continuously, and these readings, in connection with those of the ammeter and voltmeter, are all that are required to determine the impedance and phase angle of any part of the transmitter circuit, including those of the cable itself.

In the present forms of battery transmitter a square-topped wave is employed, and, in addition, it is found necessary to disconnect the battery and connect the cable to earth during a portion of each individual signal sent. The reason for this is that, in this form of wave, the cable receives a charge dependent upon the time during which the key remains closed for the signal, and when the circuit is opened it is necessary to give time for the cable to become discharged before the succeeding signal can be sent. This discharge is shown in the spark that is seen in the present form of transmitter when the circuit is broken. The percentage of time of each elementary signal during which the cable is connected to earth varies according to the cable, but in long cables it is usually about 25 per cent. of the whole time of the signal.

This means that of necessity the cable is entirely disconnected from the battery at both ends for a period aggregating six hours per day, due to the present method of sending the individual signals.

This discharge of the cable has, indeed, been turned to account for a useful purpose by the late Mr. Gott (British patents No. 10,534 and No. 22,364 of 1912), who quite recently developed a system of transmission in which the discharge of the cable is ingeniously utilised to co-operate the tongue of a relay, which causes the succeeding signal to enter the cable with the opposite sign.

This form of square-topped wave, when combined to make up letters and words, causes a broken and irregular form of current to enter the cable, which precludes the possibility of measuring the ordinary quantities, such as voltage, current, impedance and phase-angle of the different elements of the circuit. This is extremely unsatisfactory from an engineering standpoint, and retards progress.

The development of the modern artificial line for simulating the action of the cable has required a large amount of patient and careful work extending over a number of years. As soon as any form of break, with its consequent spark or arc, is removed from the transmitter circuit, and an alternating current of one frequency only is substituted, the artificial line can more faithfully represent the action of the current flowing in the real cable, and its construction may be simplified.

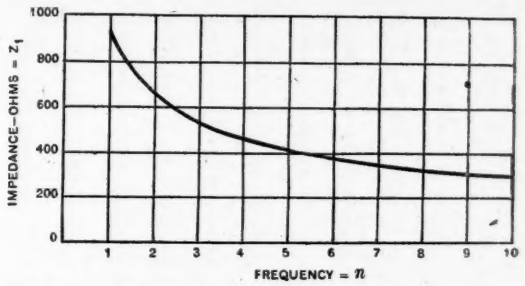


Fig. 6.—Transmitting Impedance of a trans-Atlantic Cable as the Speed of Signalling is Varied.

In the case of long submarine cables having resistance and distributed capacity, self-induction and leakance being neglected, we have the well-known sine-wave formulæ for an infinite cable—

$$e = \mathrm{E}\epsilon^{-\sqrt{\frac{1}{2}\mathrm{CR}\omega}\,x} \sin\left(\omega t - \sqrt{\tfrac{1}{2}\mathrm{CR}\omega}\,x\right) \quad \ldots \quad \ldots \quad (1)$$

$$i = \mathrm{E}\sqrt{\mathrm{C}\omega/\mathrm{R}}\,\epsilon^{-\sqrt{\frac{1}{2}\mathrm{C}\omega}\,x} \sin\left(\omega t - \sqrt{\tfrac{1}{2}\mathrm{CR}\omega}\,x + \pi/4\right) \quad (2)$$

e and i represent instantaneous values of the voltage and current at any point of the cable at a distance x from the origin and a time t; E is the maximum value of the E.M.F. applied to the cable, R and C are the resistance and capacity of the cable per unit length, ω is 2π times the frequency.

These formulæ are accurate for all practical purposes in the case of long cables, as will be shown presently.

At the transmitting end of the cable $x = 0$, and (2) becomes—

$$i = \mathrm{E}\sqrt{\mathrm{C}\omega/\mathrm{R}} \sin(\omega t + 45^\circ) \quad \ldots \quad \ldots \quad (3)$$

$$i = \mathrm{I} \sin(\omega t + \theta) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

where I is the maximum current and θ is the angle by which the current leads the E.M.F. This angle is constant and equal to 45°. The transmitting impedance of the cable is—

$$z_1 = \mathrm{E}/\mathrm{I} = \sqrt{\mathrm{E}/\mathrm{C}\,\omega} = \sqrt{\mathrm{E}/2\,\pi\,\mathrm{C}}\,\sqrt{1/n} = c_1\sqrt{1/n} \quad \ldots \quad (5)$$

where c_1 is constant for any particular cable.

$$\mathrm{I} = \mathrm{E}/z_1 = \mathrm{E}\sqrt{n}/c_1 \quad \ldots \quad \ldots \quad \ldots \quad (6)$$

Let us assume—

R = 4,895 ohms, C = 914 × 10^{-6} farads, length = 2,164 knots, which data represent one of the best trans-Atlantic cables.

Substituting in (5) and (6) we have—

$$z_1 = 923{\cdot}2/\sqrt{n}, \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

$$\mathrm{I} = \mathrm{E}\sqrt{n}/923{\cdot}2. \quad \ldots \quad \ldots \quad \ldots \quad (8)$$

The graph (fig. 6) represents the impedance-frequency curve at the transmitting end of this particular cable plotted from (7).

For $n = 5$, or at 150 letters per minute, the cable impedance is 412 ohms, or only 8·4 per cent. of the ohmic resistance of the cable. The impedance of this same cable, as measured by the ammeter-voltmeter method, for a frequency of $n = 5{\cdot}03$ is 397·5 ohms.

With 50 volts on this cable at the same speed of transmission the current flowing into the cable from (8) is I = 0·12 ampere.

The transmitting impedance is most sensitive to change of frequency at the lower frequencies, and by increasing the speed from $n = 4$, or 120 letters per minute, to $n = 9$, or 270 letters per minute, the cable impedance is decreased in the ratio of 3 to 2, and the current correspondingly increased. The same values of impedance and current deduced above apply to the equivalent artificial line, which is made to balance as far as possible the real cable.

By inserting a hot-wire ammeter in the cable itself beyond the bridge, and also connecting the transmitting end of the cable to earth, through a suitable voltmeter (preferably an electrostatic instrument, to prevent any disturbance of the bridge balance), we have the means at hand for determining the best transmitting conditions for any particular cable and frequency of signalling. Heretofore the values of the transmitting condensers in the duplex arms of the bridge have been more or less arbitrarily assigned by certain practical rules obtained by an expert study of the signals themselves. Here, however, we may approach the problem more scientifically by so adjusting the values of the condensers or inductances, or both, in the bridge branches as to produce a

maximum reading of the hot-wire ammeter in the cable itself for any particular voltage assigned. The criterion for best transmitting conditions alone would be that the transmitting impedance should be a minimum, or the current flowing into the cable as measured by a hot-wire ammeter should be a maximum for any particular signalling frequency.

This practical method is, of course, entirely analagous to the present practice of inserting a hot-wire ammeter in the transmitting antenna of a wireless station, except in the latter case we can go much further and adjust for the maximum current possible at the maximum point of the resonance curve of the antenna. In the cable circuit we are dealing, not with resonance, but with forced waves maintained by the dynamo.

Submarine cables are at present operated by primary batteries giving an open-circuit voltage of from 50 to 80. The main reason for this is, of course, the constant fear of subjecting the cable itself to undue electrical strain, particularly in the deep-sea portion, where repair is difficult and expensive. This is not the only reason, however, although it is the principal one.

The present form of battery transmitter impresses upon the cable square-topped waves, which may be analysed by Fourier's method, and in the hands of Malcolm and a few others the wave-form can be worked out and predicted as the wave passes through the cable to the receiving end. Since we know that it is only the fundamental term of the Fourier analysis which produces an appreciable effect at the receiving end, all of the harmonic waves which are required to build up the square-top form of wave are impressed upon the cable at the transmitting end, and are absorbed in the cable itself, and never reach the receiving end. These, therefore, represent superfluous electrical charge impressed upon the cable, and this charge for each signal must be got rid of before the succeeding signal can be sent into the cable.

It is, therefore, probable that a practical limit would soon be reached in the present form of transmitter, where the magnitude of this extra charge sent into the cable would become so great that there would be little advantage in further increasing the E.M.F.

The direct influence which increase of voltage produces on the amplitude of the record received as the frequency changes is shown in the graph (fig. 7). These data were obtained over a submarine

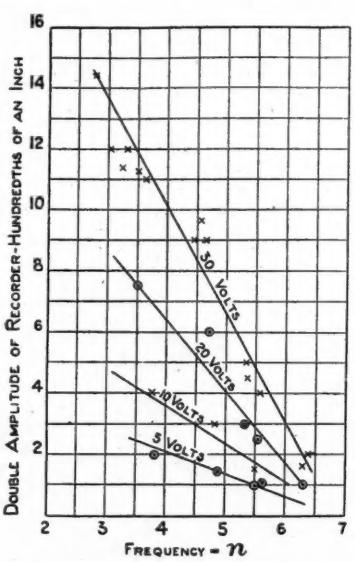


Fig. 7.—Variation of Double Amplitude of Siphon Record with Change in Frequency, Voltage Constant.

cable from New York City to Canso, Nova Scotia, of :—R = 13,700 ohms; C = 231·4 × 10^{-6} farads; length = 880·6 knots. The cable was used at the transmitting end simplex, without condensers, and at the receiving end the ordinary duplex arrangements were employed with 50 mf. condensers; the cable recorder was adjusted once for all, and remained unchanged throughout the experiments. The receiving arrangements were not particularly sensitive, and the recorder was not readjusted as the frequently was increased.

It will be observed that, within the limits of these experiments, the amplitude of the excursions of the siphon increased with the voltage for any particular frequency of the dynamo, and as the frequency was increased, the voltage remaining constant, the double amplitude of the siphon record gradually decreased. Theoretically, these lines are curved lines, but for observations up to 30 volts, with but one adjustment of the recorder, the right lines in this figure best represent the actual observations at each voltage.

It is seen that these lines converge towards a common vanishing point at somewhere about $n = 7$, which means that, with the limited sensibility of the particular recorder used (which may be considered as an ammeter if properly calibrated), we cannot expect by any increase of voltage to signal faster than about $n = 7$ with this particular cable.

This graph has been made from data of experiments made 17 years ago, and since that date, due to the great improvement in sensibility of cable relays and amplifiers, the vanishing point at the present day for this cable would be moved to the right along the axis of abscissæ, to some point corresponding to a considerably larger number than 7.

The above outline will be sufficient to show that in the case of an alternating current being impressed upon a cable, increase of voltage for signalling purposes should be considered from a new point of view, for we know that the power impressed in this case varies directly with the square of the voltage used in transmitting.

In (1) and (2) above, it is seen from the exponential factor that the maximum ordinates of the E.M.F. and current waves decay according to the logarithmic law, and that the rate of decay is dependent upon the capacity and the resistance of the cable per unit length, and also upon the frequency.

Assuming $n = 5$, or 150 letters per minute, the instantaneous value of e or i, and also the maximum volts per volt at sending end have been computed for the Atlantic cable of fig. 6, and are shown in the following table:—

Knots.	e or i.	Maximum volts per volt at sending end.
0	1	1
135	0·5135	0·5924
270	0·1755	0·3510
405	0	0·2079
540	—0·0616	0·1231
675	—0·0630	0·0729
810	—0·0432	0·0432
945	—0·0222	0·0256
1,080	—0·0076	0·0152
1,215	0	0·0090
1,350	0·0027	0·0053
1,485	0·0027	0·0031
1,620	0·0019	0·0019

These relations are shown graphically in fig. 8. It is seen from the table that the maximum voltage impressed upon the cable has decreased to 1/500 of its original value in one complete wave-length, and to 0·5924 of the original value in the first 135 knots from the transmitting end of the cable.

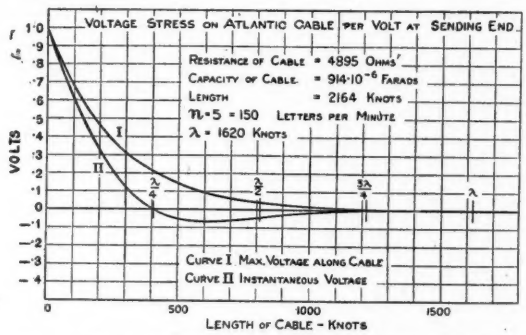

Voltage Stress on Atlantic Cable per Volt at Sending End
Resistance of Cable = 4895 Ohms
Capacity of Cable = 914·10⁻⁶ Farads
Length = 2164 Knots
n = 5 = 150 Letters per Minute
λ = 1620 Knots
Volts
Curve I Max. Voltage along Cable
Curve II Instantaneous Voltage
Length of Cable - Knots

Fig. 8.—Voltage Stress on Trans-Atlantic Cable for $n = 5$, or 150 Letters per Minute.

At this speed of signalling a complete wave is 1,620 knots in length; also we have: λ = 1,620 knots, $\tau = 1/n = 1/5$ second, total length of cable = 1·33 λ.

Rate of propagation of wave through the cable = λ/τ = 8,100 knots per second, or the time required for the wave to travel the length of the cable = 0·27 of a second.

The frequency n has a marked influence upon the rate at which the amplitude of the wave decreases as we proceed along the cable from the transmitting end. The distance at which this amplitude will have $1/e$ of its original value is the reciprocal of the coefficient of x in the exponential term of (1), or $x' = \sqrt{2/CR\omega}$ = 258 knots, or x' varies inversely with the square root of the frequency. This means that if we increase the speed of signalling from $n = 4$ to $n = 9$ the higher frequency wave will experience the same decrease in voltage in two-thirds of the distance from the transmitting end. In other words, the higher the speed of signalling attained on any cable for a given transmitting voltage the safer the cable is from electrical strain. Increase in efficiency of the cable plant means increase in safety also.

With a battery, it is possible to subject every centimetre of the cable to the full voltage stress of the battery, as occurs whenever the usual insulation resistance test of the cable is made, or in case the transmitting condenser should be accidentally short-circuited.

With the alternating-current dynamo, however, it is impossible either by accident or by design to produce in the cable in the deep sea portion any voltage, even momentarily, of more than a small fraction of the voltage used at the transmitting end. This suggests, as has been done before, that, by designing submarine cables with heavier insulation over comparatively short distances at the ends, we can employ higher voltages in signalling with no possibility of subjecting the cable to undue electrical strain at any point of its length.

Submarine cables before laying are at present subjected to a stress of several hundred volts in the cable tanks for a considerable period, and if there is a material advantage in speed in increasing the signalling voltage there would seem to be no good reason for hesitating in the slightest degree to increase the voltage moderately in actual traffic.

In a long cable there is no reactive influence upon an ammeter or voltmeter placed in any circuit at the transmitting end due to any variation in the form of apparatus inserted at the receiving end of the cable. Opening and closing the cable circuit produces no perceptible indication. The energy of the waves may be considered as leaving the transmitting end of the cable along the conductor path never to return.

We are, therefore, at liberty to consider the electrical conditions for best receiving, separately and independently of the conditions for sending, and then inquire how far these two sets of conditions can be made to harmonise with each other.

Fig. 9 shows one of the standard arrangements for operating on long cables in which the values of the condensers and the resistance of the recorder coil as shown have become more or less fixed quantities in cable practice. The condenser c is limited to this comparatively small value, as its main function is to improve the definition of letters like "s" and "h," for there is no need to correct for letters like "a" and "n."

This lack of uniform resolving power for all letters at present limits the free use of any value of condenser in this arm which would be the most suitable from electrical considerations to increase the value of an alternating current in the recorder coil.

In fig. 9 the attenuated alternating current at the receiving end

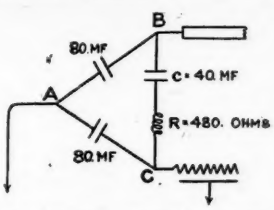


Fig. 9.—Form of Duplex Circuit used on Long Cables.

of the cable is divided at the point B of the duplex bridge, and again subdivided at A and C inversely as the vector-impedances of the paths.

In the recorder arm B C the ideal electrical conditions would be so to assign values to the receiving condenser c, and the inductance and resistance of the recorder coil, as to cause this arm of the bridge to be in resonance, entirely independently of the cable itself, the artificial line, or of any other arm of the bridge. In other words, we should so arrange matters, if we could, that if the arm B C were short-circuited on itself its natural frequency would be equal to the frequency of the current it is required to receive. In the abstract, there would be an infinite number of solutions for this arm, depending upon the stiffness function L/C selected, each solution fulfilling the condition : $C L \omega^2 = 1$.

The alternator has been designed for the particular purpose of operating a cable, and possesses some novel features. Since we cannot reduce the number of poles to less than two, we must rely on a high magnetomotive force, and a minimum clearance for the armature to produce, at such low frequencies, the voltage required. In addition, it is especially desirable to generate an accurate sine wave of E.M.F. These objects have been satisfactorily obtained in the design of the machine used in these experiments.

The resistance of each of the field coils is nearly 1,000 ohms, and the inductance of the armature largely controls the current in the armature circuit, so that the machine can be short-circuited at full voltage without harm.

In starting and stopping the dynamo no form of switch is used, but, instead, the motor which operates the dynamo, starting from rest, gradually builds up the E.M.F. from zero, which gradually dies down to zero at stopping. In this manner there is never any possibility of a "break" in any metallic circuit connected with the transmitting apparatus.

Since the dynamo transmitter comprises the power plant for an ocean cable, it must, therefore, take its place on the instrument table, where the transmitter is directly geared to it. The armature is mounted on ball bearings, and runs with remarkable silence and smoothness under load.

The developments of wireless telegraphy have introduced alternating-current dynamos of considerable power of 100,000, and even 200,000, cycles per second ; but for the present purpose we require an alternator to operate at from 4 to 10 cycles per second, and to develop 100 volts or more. This type of dynamo possesses some interest to the engineer, because it may be said to represent the extreme infra-red end of the dynamo spectrum, just as the high-frequency machines mentioned above represent the ultra-violet end. It would be strange indeed if the needs of telegraphy should be ultimately responsible for the development of both ends of this spectrum.

It is seen that once we can employ a system of signalling in which we are dealing with one fundamental frequency only, and the circuit is never broken, the process of measuring the constants of the cable itself and the most suitable bridge arrangements for high efficiency is greatly simplified.

The removal of any form of arc or spark from the cable circuit has been shown very materially to increase the accuracy of balancing the duplex bridge, while the smooth type of waves employed in sending the signals has enabled this important object to be attained with an accuracy greater than has been possible before.

Using the low-resistance coil of a transformer or auto-transformer as the actual source of E.M.F. in the circuit comprising the cable itself, enables each end of the cable to be permanently connected to earth, thus providing a drainage path for earth currents of all kinds induced in the cable, and also adding to its safety.

The present forms of cable recorders, relays and amplifiers, when relieved from the necessity of recording consecutive impulses in the same direction, are liberated from some practical restrictions which have heretofore hampered them. In the example shown, the recorder coil of the gold-wire relay oscillates back and forth at a definite frequency, and the inertia of the moving parts is, therefore, less troublesome, and we are at liberty to increase the flux of the magnetic field, as well as to reduce the control of the coil so as to allow it to vibrate more freely at its natural frequency.

No mention has been made of the possible application of this method of transmission to landlines, but it may be remarked that in the present Wheatstone automatic system there is great trouble caused by the induction of one line upon another, and if we could remove from the Wheatstone system the necessity of making and breaking the battery circuit at comparatively high voltage we could at a single stroke, very largely reduce all such inductive effects.

It is known that certain characteristics are very desirable in any cable system, such as

(*a*) All signals should represent equal lengths of time ;

(*b*) No two consecutive signals should be of the same sign ;

(*c*) The resolving power or definition of each letter of the alphabet should be as nearly as possible the same ;

(*d*) The total quantity of electricity measured in coulombs impressed upon the cable should be as nearly as possible equal to zero for any two consecutive signals.

It will be seen that the ideal solution for power transmission automatically comprises each of these conditions, and, in addition, has other advantages in safety to the cable property from undue electrical strain throughout every centimetre of its length.

FOUR YEARS' OPERATING EXPERIENCE ON A HIGH-TENSION TRANSMISSION LINE.

The following abstract of a paper by A. Bang, read before the American Institute of Electrical Engineers in June, gives the operating record of a line which transmits energy at 70,000 volts from the Pennsylvania Water & Power Co.'s hydro-electric plant on the Susquehanna River at Holtwood, to the same company's terminal station at Baltimore, Md., where the current is stepped down for distribution purposes. Practically all the load consists of synchronous machinery, such as synchronous converters, frequency changers, etc.

The line is about 40 miles long and consists now of two rows of steel towers, each capable of carrying two independent three-wire circuits. The first of these tower lines (No. 12) was built in 1910, with both circuits installed; the second (No. 56) in the summer of 1914. On this latter at present only one circuit is installed (circuit No. 6).

There is a considerable number of differences in the design of the two lines. The following is mainly a description of the new line, though wherever there is an essential difference, it is pointed out.

Towers.—The towers are galvanised steel, designed for six power cables and two ground cables (on the old line only one ground cable); they are spaced about ten to a mile and the cables on the new line are anchored at every fifth tower at least. All the towers on the new line are set in concrete foundations, while on the older line, steel tripod foundation stubs were used for the suspension towers.

The height of the tower is 44 ft., from ground to the lower crossarm. The distance between the crossarms is 9 ft., against 7 ft. on the older tower line, and the ground wires are located 4½ ft. above the upper crossarm. Contrary to what was the case on Line No. 12, where the power cables for each circuit were located all three in a vertical line one above the other, the cables on the new line have been staggered. The conductors are 300,000-cir. mil, 19-strand aluminium cable. The ground wires consist of ⅜-in. galvanised seven-strand steel cable. The insulators are of the suspension disk type, 10 in. in diameter. The units selected for the newer line have the following electrical characteristics :—

Individual dry flash-over voltage	=	95,000 volts.
Individual puncture voltage	=	140,000 to 150,000 volts.
Units on older line have a dry flash-over voltage	=	90,000 volts.
and puncture voltage	=	100,000 to 107,000 volts.

Eight units to the string are used on anchor towers and seven on suspension towers. Seven units correspond to a dry flash-over voltage of 378,000 volts.

On the old line originally, five and six units, respectively, were used for suspension and strain towers.

Electrical Data.—

Frequency	25 cycles.
Normal line voltage between phases	60,000 to 70,000 volts.
Ohmic resistance of one wire ... =	12.1 ohms (12 deg. Cent.)
Ohmic reactance at 25 cycles is =	13.1 ohms
Impedance at 25 cycles is ... ... =	17.9 ohms.
Losses in three lines at 200 amperes ... ... =	5,800 KW. or 10 per cent. when 58,000 KW. are transmitted.
Capacity current ... ... =	3.5 amperes per wire.

Operating Record.—Below is given a tabulation of all the disturbances to normal operation of the system originating in the transmission lines, together with the cause of the trouble and the year it occurred. These disturbances have further been divided into three groups, depending on their seriousness, *i.e.*, total interruptions (T.I.), where all the load was lost, though generally not more than for a few minutes; partial interruptions (P.I.), where a percentage of the load was momentarily lost; and, finally, mere voltage or frequency disturbances (V.D.), where no load whatever was lost. These disturbances have been recorded whenever the voltage changed suddenly five per cent. or more.

TABLE I.—Operating Record for Holtwood-Baltimore Transmission Line, Jan. 1st, 1911, to Dec. 31st, 1914.

Cause.	1911.			1912.			1913.			1914.			Total for four years.		
	T.I.	P.I.	V.D.	T.I.	P.I.	V.D.	T.I.	P.I.	V.D.	T.I.	P.I.	V.D.	T.I.	P.I.	V.D.
Lightning ..	23	—	10	3	19	4	3	17	11	1	6	7	30	42	32
Defective insulators ..	—	—	—	—	—	—	1	—	—	—	1	1	1	1	1
Sleet on cables	—	—	—	—	—	—	—	—	—	2	2	—	2	2	—
Birds on line ..	1	—	—	—	—	—	1	—	2	1	3	2	3	3	4
Wires blowing together ..	—	—	—	—	—	—	—	—	—	—	—	1	—	—	(1

It will be seen that the cause for all the disturbances can be covered under the five headings; of these the overwhelming cause of trouble is lightning.

It may be of interest to recount a few observations made on the effect lightning has on a transmission line in operation.

Though the lines are protected at both ends with aluminium lightning arresters, which duly discharge during storms, lightning discharges or surges will nevertheless give rise to "flash-overs" on the line, which, once established, are maintained by the power from the generators. Such flash-overs practically always start at the towers where the clearance distances to ground (*i.e.*, towers) are the smallest (a double or triple ground to the same tower is naturally in effect the same as a two- and three-wire short-circuit). The path of the flash-over

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1.—Suspension Type Insulator, Bottom-phase, removed after partial interruption.

Fig. 2.—Insulator String Punctured on Line.

Fig. 3.—Insulator String punctured by Test.

may vary. Thus, when circuits Nos. 1 and 2 originally went into service, the suspension towers were equipped with five units to the string and strain towers with six units. With this arrangement it was always found that the flash-over would occur upwards from the conductor, *alongside* the string of insulators.

Fig. 1 shows a typical string of insulators, damaged by such an arc. It can be seen how the three lower insulators are completely broken to pieces, probably mainly due to the heat generated by the arc; the bottom bolt shows a deep burn. It can also be seen from the marks on the string how the arc in this string, instead of travelling all the way from conductor to the tower in one unbroken arc, has broken into small individual arcs, each encircling one insulator. That happens frequently, though not always.

Not only the insulators, but also the cable is liable to be damaged by lightning arcs. If the arc stayed at one place it would quickly burn the cable through. As a rule it is blown away from the power house, due to its own magnetic action.

The plan was tried in 1912 of increasing the number of disks of a suspension string to seven and of a dead-end tower to eight. Before the lightning season of 1913 one whole circuit was equipped in this way; the result was, as shown by the power-house ground chart record, that in 1913 the lightning flash-overs were distributed between the two circuits as follows:—

27 lightning strokes on circuit No. 1.
20 lightning strokes on circuit No. 2.
6 lightning strokes unknown on which circuit.

In other words, the circuit with the many insulators showed the larger number of lightning strokes. Inspection showed that whenever the flash-over took place on a suspension tower (which generally was the case in preference to a strain tower) the lightning arc on a circuit with the five insulators in the string, would as usual rise upwards along the insulator strings to the crossarm above, while on a circuit with the seven units in the string the arc would in every case go just the opposite way, *i.e.*, from the conductor to the crossarm below. This was naturally due to the fact that this clearance distance for the two upper conductors was materially decreased by adding two more units to the string. For the bottom conductor, the number of flash-overs was greatly reduced. This change in the location of the arc resulted in two distinct gains. In the first place, the arc did not have nearly the same chance for damaging the insulators by heat, as it did not pass alongside them but away from them. The other advantage was that it proved to be easier to extinguish the arcs; that it could be done with much less loss of the synchronous load connected to the system (on account of the preponderance of two-wire short circuits compared with three-wire short circuits).

Altogether the number of insulators removed from the line due to lightning damage is small, not more than about 100 per year, on the average, and the number is not on the increase.

Far more important from a maintenance point of view is the continuous *deterioration* of the porcelain in the insulators, such as it was discovered a few years ago could be determined on insulators of the suspension type by means of taking insulation readings between the pin and cap (megger tests).

The first complete test of circuits Nos. 1 and 2 was made after about three years of operation, and the same line was gone over again about half a year after the first test. All told, four years' operation produced 2,640 bad units, or 11.7 per cent., an average of 2.9 per cent. per year. Judging from the last test, it seems as though this deterioration goes on at a rapidly increasing rate year after year.

The two circuits had practically the same number of bad units, but the strain towers on both circuits show a very much larger percentage (17.1 per cent.) of damaged units than the suspension units (7.6 per cent.), indicating that the horizontal strain units are very much more exposed to this trouble than the vertical suspension units.

Fig. 4.—Nicholson Rotary Fuse Bank; Fuse blowing.

After a number of these units were removed from the line, a series of tests was made in an attempt to determine the cause of this trouble. While these tests were going on, a puncture of each and every one of a string of five insulators occurred one day on the line, during actual operation. No lightning was reported, the weather was clear, and no switching was done at the time of the disturbance. Fig. 2 shows this string.

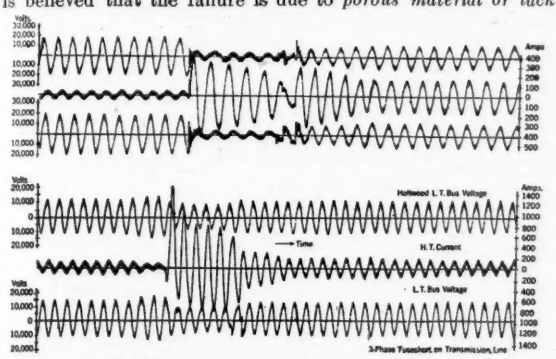
It was naturally thought that this was a case of deteriorated porcelain, which could have been caught in time to prevent failure, if only megger readings had been taken of these insulators sometime beforehand. To prove this, five units removed from the line because of low megger readings were mounted in a string and high voltage was built up on them from a 70,000-volt, 10,000-KW. transformer, with a 10,000-KW.

generator behind it. The current was limited to about 250 amperes by a resistance.

The result of this test is shown in fig. 3; when the voltage reached about 30,000 volts, the insulator punctured, burning porcelain and iron being, so to speak, shot out from the side of first one, then another insulator, leaving holes of just the same nature as found in the insulator string punctured on the line.

While the foregoing tests conclusively prove the serious nature of this insulator deterioration, they do not throw much light on the real nature and the cause of this trouble. The following tests were made with this object in view: On 24 insulators discarded, the pin, cap and cement were dissolved in a diluted solution of nitric and hydrochloric acid so as to give an unobstructed view of the surface of the porcelain, normally hidden by the pin and cap. Of these insulators seven showed clearly a tiny crack in the porcelain at the bottom of the head; three insulators showed similar cracks across the head; 13 insulators did not show any cracks; one insulator was destroyed during the test.

Trying with the megger on the cracked insulators, it could readily be shown that the low resistance was located right in the crack. On insulators where no cracks could be found, it is believed that the failure is due to *porous material or lack*



Upper diagram: Middle wave represents H.T. current at sub-station; outer ones, L.T. bus voltage at sub-station. Lower diagram: Middle wave represents H.T. current, others L.T. bus voltage at power house.

Fig. 5.—Three-phase Short Circuit on Transmission Line.

of vitrification in the burning, which gradually has allowed moisture to be absorbed by the porcelain in the same way as moisture has penetrated through the cracks in the cracked insulator.

When it was first discovered that a large percentage of the low megger readings was due to cracks in the porcelain, it was naturally feared that these insulators had lost a great part of their mechanical strength. This proved, however, not to be the case.

Working on the theory that the depreciation was at least partly due to high internal stresses, set up by temperature changes, the insulators were subjected to a hot and cold water treatment.

After each temperature change the insulator was tested with a megger and discarded if it gave a reading less than "infinity." If an insulator endured the treatment without any change in resistance it received in all 10 temperature changes, and was finally subjected to high potential. With one type of insulator no failures were recorded.

Working, on the other hand, on the theory that, at least in part, this insulator trouble was due to absorption of moisture without accompanying cracks, the plan was tried of drying out some of the insulators removed from the line, under high vacuum and at temperatures varying from 50 to 90 deg. Cent.

After only a few hours' treatment, the insulation resistance decreases materially; after 24 hours' treatment a material increase is, however, always found, and this continues steadily until many insulators reach the infinity mark, even when hot. All of them, without exception, will record infinity, when tested cold after two days' treatment.

After drying out, the insulators were given a high-potential test with 25 cycles.

The result was that out of a total of 37 insulators tested, 12 withstood a heavy flash-over test for ½ min. The rest of them punctured at voltages varying from 30,000 to 90,000 volts.

On the whole, the experiments all tend to show that the deterioration of the type of insulator in question is not due to electrical but rather to mechanical and ceramic causes.

The most common cause of sleet trouble is that with the arrival of milder weather, the sleet will often fall off one full span or several spans at one time, but still remain on other spans. Such conditions result in unequal loading, and if the wires of different phases are in the same vertical plane, they are liable to come in touch with each other and produce short circuits. The few disturbances recorded as caused by sleet on the Baltimore transmission line have all been of this nature.

In building the new line it has been attempted to minimise this trouble by having the middle crossarm extend farther out than the top and bottom ones.

Another method of preventing sleet trouble is simply to keep the transmission lines so hot that no sleet whatever can be formed on them.

The birds troubling this line are turkey buzzards, and they often choose the towers as a resting place, and are liable to ground the line to the tower through their own bodies. There is especial danger if they sit on the crossarm right below the live wire. Often they will fall down without even causing a voltage disturbance, but frequently they will give rise to an arcing ground, which may even develop into a two-wire short circuit.

The one voltage disturbance recorded as being due to wires blowing together is of no special interest.

In order to maintain continuous operation, several different protective devices have been adopted.

Trouble from defective insulators, sleet, buzzards, and the wind swinging the wires together, generally results in grounds or short circuits that persist on the system until the voltage is taken off the faulty line. The method to safeguard operation is to cut the damaged line out.

The system in use consists simply of overload relays at the power house connected in series with the line current transformers and also one relay in the ground connection for the neutral of each transformer bank. At the sub-station, reverse current relays take the place of the overload relays at the power house. To prevent all three lines from going out by relay action, in case there should be a short circuit on all the lines at the same time, the trip circuits are interlocked.

The interlocking relay arrangement is not sufficient as lightning protection, as lightning flash-overs very often occur on both circuits Nos. 1 and 2 at the same time. (It still remains to be seen whether they will occur on all three circuits at the same time.) When both circuits are in trouble at the same time, the clearing of both means a total interruption. Experience showed that if only some means could be found to extinguish the power arcs, an interruption might be avoided.

The system in use is the arc extinguisher arrangement invented and designed by Mr. L. C. Nicholson, Buffalo, N.Y. The principle of this arrangement is to shunt any arc that arises on the line with a fuse wire, so that the current, as long as the fuse lasts, will prefer this path to the arc. The fuse is calibrated to blow in from 5 to 10 cycles (25-cycle system), and this short time, experience has proved, is enough to extinguish the arc on the line; therefore as soon as the fuse blows, the line will be clear again. The fuse wires are connected across the proper wires automatically by means of specially designed magnetic relays and switches. The whole arrangement is placed right outside the power house. The design of the equipment is such that seldom more than one cycle will pass from the time the lightning arc is established until the switch is closed. It is in this speed that the apparatus has its greatest advantage, since it allows the arc on the line so very little time to spread and do damage.

Fig. 5 shows two oscillograms which illustrate the action the short-circuiting of the lines with such fuses has on the system. This device is especially satisfactory on the Baltimore line when only a ground or two wire short circuit occurs; in such cases it saves all, or practically all, the synchronous load. On three-phase short circuits generally about 50 per cent. of the load can be saved.

In 1913 and 1914 it cleared the line 25 times out of 40 times when it was struck.

Another device in use, not to prevent lightning flash-overs, but to minimise their consequences by extinguishing the arcs, is a so-called field destroying and restoring device, invented by Mr. F. E. Ricketts, of Baltimore. The principle on which it operates is that when a short circuit occurs on the line,

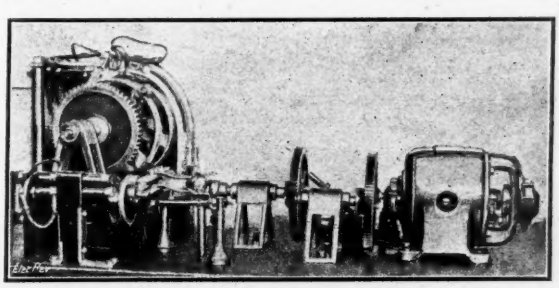


Fig. 6.—Relay Motor and Revolving Drum for Ricketts Field Destroying and Restoring Device.

the field of all the generators is for a moment destroyed, so as to allow the arc on the line to die out on account of lack of voltage, and then immediately after be built up again, so as to force the synchronous load into step again before the synchronous converters, frequency changers, etc., have come to a stop.

The switching for this device is operated by relays, the action of which is delayed four seconds to give the Nicholson arc extinguisher and interlocking relay arrangement the first chance to clear the trouble.

To operate it a small continuously running motor is clutched to a contact drum, which, on starting, simultaneously opens all the ordinary field circuit breakers, at the same time short-circuiting the field windings across their respective discharge resistances, thus allowing the field gradually to die out and the line voltage to be reduced correspondingly. Meanwhile the drum continues to revolve and will, after a predetermined time (originally 5 sec., now 1½ sec.), close other contacts which have the effect of slamming all the circuit breakers in again. Immediately the fields and line voltage start to build up again. After some surging between the generators themselves individually and the generator and synchronous load, the voltage will again be normal, generally after about one minute. The drum continues to rotate until it has made one complete revolution, after which time it is disengaged from the motor and the whole equipment is ready for another operation.

The record for this device shows for 1913 and 1914 a total number of 12 successful lightning operations and 4 failures.

The fuse arrangement has been given preference and first chance for acting, mainly on account of its quickness of action, which saves the line from too severe damage, and also on account of the excellent results it has produced in case of the lesser lightning disturbances like grounds and two-wire short circuits.

The field-destroying device treats all lightning disturbances as equally severe and produces the same disturbance on practically all of them, but seems, on the other hand, to have the great advantage of extinguishing the arcs with more certainty.

While lightning still gives rise to a number of disturbances, these have been very materially reduced by the use of special protective devices. As to sleet, special operating methods have been adopted during such storms, which, it is believed, will prevent trouble from this cause. The approaching danger from deterioration of the insulators has been discovered at an early stage, and rigid and repeated elimination tests of bad insulators with the megger, have been adopted as part of the routine maintenance, so that it is felt that *operation* will have but little to fear from this source.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this Journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

10,433. "Automatic electrical human target." J. Callaghan. July 19th.

10,453. "Electrical driving of spindles." Siemens Schuckertwerke G.m.b.H. July 19th. (Convention date, July 20th, 1914, Germany.) (Complete.)

10,454. "X-ray apparatus." British Thomson-Houston Co., Ltd. (General Electric Co., United States). July 19th.

10,485. "Electro-magnetic recording apparatus for telegraph circuits." R. W. James. July 19th. (Alexander Hill Annand.) (Complete.)

10,521. "Electrical element for heating machine tools." H. Tomlinson-Lee. July 20th.

10,535. "Electric arc lamps." Clarke, Chapman & Co., Ltd., and R. C. Hakris. July 20th. (Complete.)

10,552. "Holder or gallery for securing gas and electric shades and the like." W. G. Scott. July 20th.

10,560. "Armouring of electric cables for motor-cars and similar purposes." F. J. Chaplin. July 21st.

10,598. "Rheostat switches and the like." J. Roothaan & Ferranti, Ltd. July 21st. (Complete.)

10,604. "Electrolytic cells." H. R. Nelson. July 21st. (Convention date, Aug. 17th, 1914, United States.) (Complete.)

10,605. "Method of electrolysis." H. R. Nelson. July 21st. (Convention date, August 17th, 1914, United States.) (Complete.)

10,639. "Portable telegraph and telephone apparatus, applicable for signalling purposes." C. Doherty & Underwood, Ltd. July 22nd.

10,667. "Electric alarm or calling devices used in receiving apparatus, and more particularly in wireless receiving apparatus." A. H. Morse & The Indo-European Telegraph Co., Ltd. July 22nd. (Complete.)

10,668. "Electric welding machines." Deutsche Schweissmaschinen-Bau-und-Vertriebs G.m.b.H. July 22nd. (Convention date, July 22nd, 1914, Germany.) (Complete.)

10,669. "Telephonic reproducers." C. Stille. (Addition to 9,644/13.) July 22nd. (Complete.)

10,672. "Wireless type-printing telegraph systems." L. C. Stewart and J. J. Little. July 22nd.

10,676. "Ampere-hour electricity meters." Landis & Gyr Akt. Ges. July 22nd. (Convention date, July 22nd, 1914, Germany.) (Complete.)

10,680. "Couplings for armoured or protected cables and electric conductors for use under water and elsewhere." V. C. Hastings & G. Fiorentino. July 22nd.

10,681. "Utilising electric energy." E. Bachelet. July 22nd.

10,706. "Electrically operated intermittent motion in cinematograph apparatus applicable to other purposes, such as ratchet or feed gearing or free-wheel mechanism." A. C. Moll & A. D. Moll. July 23rd.

10,709. "Automatic telephone transmitters." Eastern Telegraph Co., Ltd., & B. E. Phillips. July 23rd. (Complete.)

10,711. "Cooling or ventilating devices for dynamo-electric machines." A. Mond. July 23rd. (Maschinenfabrik Oerlikon, Switzerland.) (Complete.)

10,722. "Electrical heating and cooking apparatus." C. G. Nobbs, Sen., and W. W. Nobbs. July 23rd.

10,726. "Electro-magnetic levitating apparatus." E. Bachelet. July 23rd.

10,730. "Screw fittings for electric lampholders, ceiling plates, and the like." W. Parsons & Birmingham Central Supply Co., Ltd. July 23rd.

10,739. "Method of generating high-frequency electric currents." T. F. Wall. July 24th.

10,752. "Electric motor starters and controllers." E. Schattner, T. G. Travis, & J. R. Walton. July 24th.

10,755. "Coil for electrical purposes and method of winding same." H. Wade. July 24th. (J. R. Leeson, United States.) (Complete.)

10,759. "Methods of signalling on submarine cables and other telegraphic circuits." C. V. Drysdale. July 24th.

10,762. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., & A. A. Pollock. July 24th.

10,769. "Crystal detectors, particularly for wireless signalling." Sterling Telephone & Electric Co., Ltd., and T. D. Ward-Miller. July 24th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1913.

25,951. Trolley Wires for Electric Railways and the like. F. Lautenbacher. November 12th. (December 2nd, 1912.)

26,631. Electric Clocks. H. Aron. Elektricitätszahlerfabrik Ges. November 19th. (February 26th, 1913.)

26,899. Electrolytic Measuring Instruments. H. S. Hatfield and Chamberlain & Hookham, Ltd. November 22nd.

26,905. Circuit Arrangements for Telephone or other systems. Siemens Bros. & Co., E. A. Laidlaw, and W. H. Grinsted. November 22nd.

1914.

2,214. Spark-gap Devices for Wireless Telegraphy. R. Goldschmidt. January 27th. (January 27th, 1913.)

2,290. Electric Massage Apparatus. M. Jakowlew. January 28th.

4,447. Electric Switches. T. Jessen. February 20th. (February 24th, 1913.)

4,664. Production of Electric Waves for Wireless Telegraphy, Telephony and the like. Polyphos Electrizitäts Ges. February 23rd. (February 26th, 1913.)

8,800. Circuit Arrangements for Telephone Systems. Siemens & Halske Akt. Ges. April 7th. (April 7th, 1913.)

8,806. Holders for Electric Glow Lamps. C. A. Schaefer (firm of). April 7th. (April 15th, 1913.)

9,103. Circuit Arrangements for Telephone Systems. Siemens & Halske Akt. Ges. April 9th. (Addition to 22,013/10.)

9,105. Telephone Exchange Circuits. Siemens Bros. & Co. (Siemens and Halske Akt. Ges.) April 9th. (Additions to 11,251/10 and 4,698/12.)

9,110. Incandescent Electric Lamps. C. Gladitz. April 9th.

9,278. Magneto-electric Machines for medical use. E. C. R. Marks. (Soc. Gallot et Cie.). April 14th.

9,718. Electro-mechanical Selector. E. G. Godfree. April 20th.

10,171. Carbon Electrodes for Galvanic Cells. V. Scholz. April 24th.

11,844. Induction Meter with Three-armed Driving Core. Allgemeine Elektricitäts Ges. May 13th. (May 17th, 1913. Addition to 3,912/14.)

13,062. Electric Signalling Systems, particularly for use in Mines. Sterling Telephone & Electric Co., Ltd., and F. G. Bell (partly Telephon Fabrik Akt. Ges. vorm J. Berliner). May 27th.

15,939. Starting Devices for Electric Motors. W. G. Wilson & P. L. Harlow. July 3rd.

15,946. Junctions for Overhead Trolley Wires. Cedes Electric Traction, Ltd., & K. D. Bowen. July 3rd.

16,093. Armature Windings of Electric Motors or Dynamos. W. H. Scott. July 6th.

16,315. Electrical Device for Controlling Race-starting Barriers. A. Burt. July 8th.

16,342. Telegraphy. E. C. R. Marks (International Quadrupluex Co.). July 8th.

16,418. Relays and Indicators. Sterling Telephone & Electric Co. (Telephon Fabrik Akt. Ges. vorm J. Berliner). July 9th.

16,471. Electric Relays. Eastern Telegraph Co. & B. Davies. (Cognate application, 17,452/14.) July 10th.

16,712. Telephone Systems, more particularly for Police and Fire Alarms. G. L. Hughes & R. E. Cooper. July 13th.

16,979. Cooling Arrangements for Dynamo-electric Machinery. Siemens-Bros. Dynamo Works, Ltd., & E. O. Kieffer. July 17th.

17,133. Electro-deposition of Metal upon Metal by means of High-current Density, specially applicable for Coating Printing Rollers, Hydraulic Rams, and other like purposes. T. R. Harris. July 20th.

18,607. Attachments for Telephones and the like. K. E. Zierau. August 12th.

18,661. Electric Signalling Systems, particularly for use in Mines. Sterling Telephone & Electric Co., Ltd., F. G. Bell, and J. W. Dungey. (Patent of addition, 13,062/14.) August 14th.

18,882. Systems of Electric Distribution. British Thomson-Houston Co. (General Electric Co.). August 20th.

19,441. Electric Staff Exchangers. A. Douglas & H. H. Hodgson. September 4th. (October 28th, 1913.)

19,587. Electric Circuit Interrupting Means. British Thomson-Houston Co. (General Electric Co.). September 9th.

20,286. Electrical Heating Unit. F. W. Ball. September 28th.

21,046. Magnetic Lock for Miners' Lamps. John Davis & Son (Derby), Ltd., & W. H. Davis. October 16th.

23,293. Electrical Water-heater. S. le F. Varvel. November 30th.

24,078. Construction of Laminated Slot-keys for Dynamo-electric Machinery. C. B. Burdon (Siemens Schuckertwerke Ges.). December 15th.

1915.

131. Electric Fusible Cut-outs. H. P. Liversidge & Pennsylvania Appliance Co. January 4th.

821. Circuit Arrangements for Telephone Systems. W. H. Grinsted. January 18th.

2,767. Manufacture of Electrodes for Electrolytic Purposes. Siemens and Halske Akt. Ges. February 20th. (February 21st, 1914. Addition to 605/09.)

5,184. Electric Light Systems, more particularly adapted for Vehicles. Robert Bosch (firm of). April 6th. (June 8th, 1914.)

6,618. Electric Motors or Dynamos. W. H. Scott. May 3rd. (Divided application on 16,093/14, July 6th.)

6,619. Brush-gear for Electric Motors or Dynamos. W. H. Scott. May 3rd. (Divided application on 16,093/14, July 6th.)